ASSESSMENT OF THE IMPACT OF SMALL SCALE MINING ON LAND RESOURCES IN TARIME DISTRICT, TANZANIA

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A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS IN NATURAL RESOURCE ASSESSMENT AND MANAGEMENT OF THE OPEN UNIVERSITY OF TANZANIA

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CERTIFICATION

The undersigned certifies that she has read and hereby recommends for acceptance by the Open University of Tanzania a dissertation titled: "**Assessment of the Impact of Small Scale Mining on Land Resources in Tarime District, Tanzania**" in partial fulfillment of the requirements for the degree of Master of Arts in Natural Resource Assessment and Management of the Open University of Tanzania.

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Dr. John P. A. Msindai

(Supervisor)

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Date

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DECLARATION

I, **Kisiri T. Chacha**, do hereby declare that this dissertation is my own work and that it has never been and will not be presented to any university or higher institution of learning for a degree or similar award.

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Signature

……

Date

DEDICATION

This dissertation is dedicated to my Father Kisiri Rukwi and my Mother Agness Kisiri who tried and managed to unite clans, and encouraged me to work hard in my studies. May my dearest father rest in peace. Also to all family members; most of all my beloved wife Rosina Kisiri and clan members, my children Marwa Kisiri, Mwita Kisiri, Matinde Kisiri, Matoke Kisiri, Otaigho Kisiri, Ghati Kisiri and Annie Kisiri, my sisters Ghati Oh Nyambhoha and Nchagwa Kisiri and my brothers Masire Kisiri and Joseph Kisiri. May our almighty God bless them all.

ABSTRACT

The study assessed the effects of artisanal mining on land, water and forest resources conducted in Tarime Districts (Mara Region). The study went further and examined the adaption and coping mechanisms of the surrounding communities to the impacts of artisanal and small scale mining on natural resources where simple random and purposive sampling techniques was used. The study used observation, documentary reviews, interview and questionnaires to collect the data required. The data was analyzed using IBM Statistical Package for Social Sciences (SPSS) and thematic content method. It was found that artisanal and small scale mining activities contributed–to land surface and soil destruction, erosion, land pollution, water pollution, outbreak of diseases, occupational diseases (silicosis, mercury poisoning), respiratory problems, deforestation, death and injuries. Land for cultivation has greatly diminished; and now there is great competition for agricultural land and for grazing of livestock. Furthermore it was found that the local communities used the following coping mechanisms to protect themselves from poverty such as artisanal and small scale mining in the dry periods, carrying people and goods using motor cycles and cultivating near rivers and far from the mining areas. It is fairly concluded that, notwithstanding the contribution of the ASM to the local and national economy at large, the ASM have a negative impacts to the environment of the neighboring communities. The situation experienced by the ASM provides the ground the following recommendation to be taken into consideration. Introduction of education and training to the ASM and neighboring communities, introduction of capacity building through financing programs and capitalization, supply modern and technological equipments.

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LIST OF ABBREVIATIONS AND ACRONYMS

ASM	Artisanal and Small Scale Mining
BAGMC	Barric Africa Gold Mining Company
DEC	District Environment Council
ESM	Earth System Modal
IFC	International Finance and Co-operations
IIED	International Institute for Environment and development
MNC	Multinational Mining Company
OUT	Open University of Tanzania
SPSS	Statistical Package for Social Science
WBCDD	World Business Council for Sustainable Development
WEO	Ward Executive Officer
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Introductions to the Research Problem

Artisanal and small-scale mining is prevalent in many developing countries; and it involves large populations of poor people who are often controlled by just a few agents who pay low prices. At other end the mineral trade in gold, diamonds and other gemstone are sold in sophisticated markets in the world's most economically vibrant cities. In many parts of the world, artisanal or small-scale mining (ASM) activities are at least as important as large-scale mining activities, particularly in terms of the numbers of people employed. ASM can play a crucial role in poverty alleviation and rural development; most of those involved are poor and mining represents the most promising, if not the only, income opportunity available.

However, the sector is perhaps better known for its high environmental costs and poor health and safety record. Many continue to view it as dirty, unprofitable and fundamentally unsustainable. According the report commissioned by MMSD countries from Africa are Tanzania, Ghana, Burkina Faso, Malawi, Mali, Mozambique, South Africa, Zambia and Zimbabwe while Peru, Ecuador, Bolivia and Brazil in South America. China, India, Indonesia and Papua New Guinea are from Asia. In Tanzania for instance the ASM is rampant in almost all regions of mainland. The interlacastrine regions of Mara, Mwanza, Simeyu, Kagera, Geita, Rukwa, Katavi, Mbeya, Songwe, Njombe, Ruvuma, Morogoro, Arusha and Tanga. Meanwhile the impacts of small-scale mining stay behind at the local mining sites, where environmental degradation, social problems abound and economic

development possibilities remain limited. Small-scale and informal mining is particularly widespread in developing countries of Africa, Asia and Latin America (Hilson, 2003 and 2015).

The Mara River forms a trans-boundary river basin, which plays a vital role in providing the bulk of water that sustains the livelihoods of many people. The 350km long river supports both Maasai Mara Game Reserve of Kenya and Serengeti National Park in Tanzania. The Mara river basin also forms a pasture for domestic animals such as cows, goats, sheep and donkeys (GLOWS-FIU, 2007; WREM-International Inc, 2008).

The Mara river basin begins in an escarpment and the rangelands, soils of volcanic origin are rich and dark soil that stretching from Lake Victoria up to Mau forest escarpment. The strip is said be rich in a varieties of minerals such as gold, slates and sand. Other potential resources include kaolin, limestone, and gemstones. The Mining activities range from artisanal, small scale to large scale levels. The mining activities are disruptive to other land uses, can cause significant long term environmental despoliation and often make heavy demands on water resources.

Due to the abundance of numerous natural resources the district has attracted more population from different areas including the neighboring country of Kenya. The mining activities regardless of scale and levels have greatly affected other land uses, forests, water resources and other social welfare such as health, sanitation and education (GLOWS-FIU, 2007; WREM-International Inc, 2008).

The study is therefore addressed these environmental impact fueled by these artisanal miners as addressed by the Tanzania mineral policy visions and objectives such as promoting safety and maintaining hygiene conditions and protecting the environment in mining areas, URT (2009).

1.2 Statement of the Research Problem

The mining sites of Kemakondoro, Kibaga and Nyabigena are situated in Rebu, Kenyamanyori and Nyamongo wards all stretches along the Tran boundary Mara River Valley originating in Mau escarpment of Kenya to the Lake Vivtoria in Tanzania.

The situation in Kemakondoro, Kibaga and Nyabigena reveals a degradation of natural resources, increasing the vulnerability of the poor as a result of ecosystem stress, competition for space, soaring food and energy prices and climate change. Concerns about the implications of environmental degradation have never been documented and shared as today. To this end, the study seeks to assess the impacts of mining on land, water and forest resources which principally bear the livelihoods and the livelihood strategies being adopted by local communities thus making an analytical comparison of issues that will emerge from the study as well as examine feedback loops and recommend appropriately. The study is urgently needed to assess the diminishing natural capitals which are essential for the sustenance of the communities within the mining areas. The research intends to create environmental awareness to the surrounding communities so that corrective measures are planned and undertaken as indicated by the Tanzania National Mineral Policy of 2009.

A small-scale miner is, in effect, a subsistence miner. They are not employed by any medium or large mining company, but rather work independently, mining or panning for gold using their own resources. Small-scale mining includes enterprises or individuals who employ workers for mining, but generally working with simple hand tools of which most of those tools are local made as in Kemakondoro Kebaga and Kenyamanyori study area.

According to Garvin et al, (2009), studies by Kumah (2006) on the sustainability of gold mining sector, using Ghana as a case study revealed that, gold mining presents a paradox: it helps the general economy at the national level but at the local level, individual communities are faced with social and environmental problems as seen in Kemakondoro Kebaga and Kenyamanyori study area.

In addition, recent studies have also shown that poverty is pervasive and endemic in mining communities. Some studies suggest that mining companies have taken over vast lands in their operational areas and deprived local communities of their chief source of livelihood: land and natural resources (Akabzaa, 2009). This study on these three cases (Kemakondoro Kebaga and Kenyamanyori) based on the small scale miners will add more knowledge to the policy makers, planners, researchers on the real situation, their activities, benefit and their impacts to the environment as whole.

1.3 Objective

1.3.1 General Objective

This study is aimed to assess the impact of ASM on natural resources in Tanzania.

1.3.2 Specific Objectives

(i) To examine the major natural resources under threat from ASM activities

(ii) To evaluate the effects of artisanal mining on the resources

(iii) To examine the coping mechanisms of neighboring communities to the impacts of artisanal mining on resources.

1.4 Research Questions

(i) What are the major natural resources that are threatened small scale mining activities?

(ii) What are the effects of artisanal mining on land, water and forest resources?

(iii) What are the coping mechanisms of the surrounding communities related to the impacts of small scale mining?

1.5 Significance of the Study

The study is written in factual terms, hence will broaden the understanding of the reasons and impact of ASM in Tarime District and Tanzania as a whole. Mining operations in Tanzania bring direct health and occupational health to mine workers as well as environmental, pollution and social disruption around the mines sites (Ministry of Energy and Mineral, 2009). To the national economic growth the study will alert the government to use its ultimate capacities to secure all areas with such activities in order to restore the deteriorating situation. The study also will create awareness among the people living around the mining areas on environmental protection. Also the study will enable individual's accountability in managing the

land, water and forest for his/her economical growth. The study will induce recommend to the government to create conducive working condition to the society to practice the sustainable economic development rather than weak sustainability. This has been clearly illustrated by the mineral policy of Tanzania, which focuses on strengthening of monitoring, and mining regulation put forward to reduce or eliminate the adverse effects on health and safety, environment and social issues (Ministry of Energy and Mineral, 2009). This will expand and promote the environmental awareness to the society and miners.

1.6 Scope of the Study

This study is focused on impact of ASM on land, water and forest resources. Covering the three objectives firstly examining the major natural resources under threat from ASM activities, secondly to evaluate the effects of artisanal mining on land, water and forest resources and finally to examine the coping mechanisms of neighboring communities to the impacts of artisanal mining on resources in three wards like Kemakondoro, Kebaga and Nyamongo.

1.7 Structure of the Study

The research study will include four main parts; the first one is the Title Page which displays the Heading/Tile of the study, name of the author and the intention of the study (a prior requirement for the award of Masters Degree).

The second part is the Preliminary pages which in there are copyright page, certification page, declaration page, dedication page, an abstract note, table of contents and a page of list of abbreviations and acronyms.

The third part contains the main body of the research. This part is arranged in Chapters where chapter one which shows the Introduction to research problem, the statement of the problem, Objectives for the study, research questions, significance of the research, the scope of the research and the structure of the research.

The second chapter (Literature review) comprises of introduction, definition of the terms, theoretical framework, conceptual framework and the research gap.

The third chapter if is titled research methodology, this chapter provides the information on area of study and the whole stages to be involved to conduct findings at the field. It includes introduction, research design, and area of study, population sampling, data collection, ethical implication, and limitation of the study.

The fourth chapter is titled research discussion on finding results which contains introduction, general characteristics of respondents.

Chapter five is titled conclusion, recommendation and area for further studies; this is only for conclusion, and recommendation for action to solve the problem.

The last part is termed references of the authorities consulted for using their documents

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents the literature review of the study as follows; the first sub-section examines the theoretical literature of the study. The second sub-section presents the empirical literature which includes the general literature overview, definition of terms, theoretical literature review, mining policies acts and the research gap.

2.2 Definitions of Terms

2.2.1 Artisanal and Small Scale Mining

Artisanal and small scale mining are viewed as informal economic sectors that have a significant contribution to the national economy and livelihood for rural population in developing countries of Africa, Asia and South America. The mining communities are therefore perceived to experience poverty in the midst of plenty (Oyejide and Adewuyi, 2011; Obeng-Odoom, 2012). Ideally, the change in the socio-economic outlook of the people in mining communities should be sustainable. However, instead of propelling the social-economic development of the communities and nation, many developing countries with abundant natural resources are confronted with the issue of ‘resource curse’ phenomenon. This theory postulates that the existence of mineral resources in many Third World countries has turned out to be a curse rather than a blessing, as mining companies, governments and other actors siphon away their wealth leaving the communities at the sources of

the wealth battling with the plethora of economic hurdles which sometimes lead to social unrest and conflicts.

According to the Blacksmith Institute (2011), artisanal and small scale mining refers to mining activities that use rudimentary tools and methods to extract and process minerals and metals on a small scale. Hentschel et al. (2002), on the other hand, refer to the process as mining by individuals, groups, families or cooperatives with minimal or no mechanization, often in the informal (illegal) sector. The mining can include activities as simple as panning for gold in rivers to as complex as development of underground workings and small scale processing plants. To differentiate between artisanal and small scale miners - the artisanal miners work independently; mining or panning for gold using their own resources while small-scale mining includes enterprises or individuals who employ workers for mining; but generally working with hand tools (IFC, 2008).

2.3 Theoretical Framework

The study is based on three theories, the classical theory of the informal sector, the tragedy of the commons and the relevant planning theories.

2.3.1 The Classical Theory of the Informal Sector

The Classical Theory of Informal Sector was postulated by Gibson and Kelley in 1994 after observing that the theoretical expositions about the informal sector were scattered. According to Gibson and Kelley (1994), the unifying principle which underlies literature on informal sector is that it (i.e. informal sector) arises from the capital-limited nature of the economy where capital is in short supply. The notion is

that the informal sector is limited by exogenously given level of demand which forces unemployed workers into the informal sector. Furthermore, he observed that the informal sector produces neither capitalists nor workers but rather they constitute a distinct social class.

Relative to large scale mining activities, the artisanal mining activities are less capital intensive. The artisanal mining activities have emerged due to the inability of the labour force to be employed in the large scale mining firms owing to the mismatch of skills. As a generalization, informal sector technologies including the ones used by the artisanal mining workers are rudimentary and labour productivity is characteristically low (Gibson and Kelley (1994). According to IIED and WBCSD (2002) and Clausen et al. (2011), artisanal mining activities in international development circles are identified as the most rudimentary branch of the mining sector. It is usually defined as a low technology, labour intensive mineral processing and excavation activity. Clausen et al. (2011) added that most artisanal mining takes place in the informal sector, outside legal regimes. Estimates indicate that about 90 percent of artisanal miners operate informally and thus illegally.

To sum, the rudimentary technology, labour-intensiveness and limited number of employees per firm, largely illegal and low productivity attributes of artisanal mining situates the sub-sector perfectly into the informal economy; hence the Classical Theory of Informal Sector as a relevant theoretical underpinning. From a livelihood‘s perspective, artisanal and small scale mining affects all the assets or dimensions considered as fundamental for the survival of people in mining

communities either by making them to be able to cope, reduce or manage risks and shocks or render them more vulnerable.

2.3.2 The Tragedy of the Commons

As exemplified by Hardin‘s theory of the Tragedy of the Commons in 1968, the artisanal mining workers obtain the ore from an environment treated as common-pool resource for their individual economic satisfaction (Ghatak, 2005; Hardin, 1968 in Agyeman et al., 2012). This phenomenon is supported by earlier Clausen (2011) and other‘s position that most artisanal mining takes place in the informal sector, outside legal regimes.

Treating the environment which is the source of the mineral ores as common-property resource, artisanal mining workers even if they encroach onto the concessions of large scale mining firms. Furthermore, owing to the treatment of the land as common-property, inhabitants in the mining communities look up to the large scale mining companies for employment. The large scale mining thus gives priority to the inhabitants of these mining-host communities in times of employment. Where, the large scale mining companies are unable to employ the inhabitants due to mismatch of skills, the inhabitants take to artisanal mining activities by sometimes encroaching on the large scale mining companies‘ concessions, as a way of compensating themselves. The ASM treat water bodies they process their ores in as common-property resources and are mindless of polluting them. They expose mercury into the environment with impunity while not remedial action is taken to reclaim the lands they mine on.

The ramifications of the activities of the artisanal mining workers are, however, borne by the entire society. Diseases associated with the artisanal mining activities do not only affect the artisanal mining workers but the entire members of the society. The tragedy of the commons thus underpins the operations of the artisanal mining workers due to the treatment of the mineral bearing land as common-property which individuals are to exploit for their individual interests but the consequences are borne by the entire society.

2.3.3 Relevant Planning Theories

Beside the Classical Theory of Informal Sector and the Tragedy of the Commons identified to underpin the activities of artisanal mining workers, several other planning theories appear to explain the activities of artisanal mining workers. Their prescriptions seem relevant to strike a balance between economic and social development as well as environmental sustainability. The planning theories used in this study include the advocacy theory and the communicative/collaborative theory.

(a) Water/river capital

The grinding of rocks, processing and washing operations are worked within or alongside rivers, streams, ponds, springs and other water bodies (Mwami, 2002). According to Harkinson (2003) as cited by Amponsah-Tawiah & Dartey-Baah (2011) the separation of gold from unwanted rock particles are made using heavy metals like mercury. The miners use a variety of chemicals composed of carbon and nitrogen, which is highly toxic and mainly produced for the mining of gold and silver. Armah et al (2010) wrote that the chemicals help to dissolve these metals and

their ores. The amalgamation of cyanide with water could be deadly to aquatic and human life. Hilson (2003) lamented that the user of the river water at the lower valley unknowingly or ignorantly utilizes the polluted water for domestic uses.

(b) Land capital

The expansion of ASM in farmland increases environmental destruction risks, especially in areas that are already vulnerable, such as the Lake Victoria catchment area including Mara Region. The local communities in the region are largely dependent on crop and livestock production for their livelihoods. The long term implications of continued mining activities include accelerated food insecurity, generation of a landless class, increased poverty, and rapid environmental degradation, including vegetation and topsoil loss.

These negative social and environmental problems associated with artisanal mining activities have implications on natural capitals which are source bases for the livelihoods and food security situation of rural dwellers. This is because the majority of local communities depend on land for their survival and sustenance. The arable lands are turned into holes, pits giving room for the formation of gullies. Forests are destroyed. Soils are degraded by acidic or in certain cases basic effluents. Where mineral discoveries are found in the resources like forests, wetlands and to the natural springs it leads to excessive destruction of the resources.

In Tanzania, there are thousands of artisanal operating mines scattered everywhere, almost in all regions. The activities of these petty miners have affected the farmlands of thousand local communities (Garvin et al, 2009:573). This means, local

community members would have to seek /construct alternative livelihoods to make a living as they have been their main source of sustenance. The adoption of livelihood strategies or coping mechanisms is therefore a key to the construction of livelihoods and livelihood outcomes within an ever changing social, institutional, political, economic and environmental context, where people strive to make a living (Ellis and Ade Freeman, 2005).

Similarly, research conducted by Action Aid Ghana (2006:18) in Obuasi, a mining town in Ashanti Region of Ghana, revealed that large areas of land previously under cultivation are believed to have been contaminated through gold mining activities and toxic water pollution. This has gravely affected food security in the operational areas. The cultivation of fruit and vegetables such as local crops, including 'Obuasi oranges' on polluted land poses a risk to the health of inhabitants and prevents them from selling their produce on both international and local markets. Likewise, strategies of alternative livelihoods such as grass cutter rearing, petty commodity production, fishponds, batik tie and dye production and oil palm cultivation, have failed to replace people's food security situation following their loss of land. Furthermore, cyanide spillage and tailing have also caused tremendous and sometimes unbearable damage to farmlands and water resources in many mining communities.

2.3.4 The Economic Theory of Property Rights

As mentioned earlier, the economic justification of property rights is particularly important when it comes to regulating an economy. Before it is applied to ASM, it is necessary to introduce the main ideas underlying this understanding of the law.

Generally, the economic analysis of law is concerned with the economic implications of legal systems (Trebilcock, 1991). Basic economic models of analysis are applied to legal rules. Many proponents of this theory suggest that almost all aspects of a legal system follow an inherent economic logic and at least partially serve economic purposes (Posner, 2006). One can basically distinguish between two types of economic analysis of law. Only one had a positive, descriptive analysis that makes predictions as to what the economic consequences of a certain rule or policy will be. This mode of analysis uses economic assumptions as to the behavior of individual actors: that individuals act rationally out of self-interest so as to maximize their personal wealth or benefit, and that they respond to incentives while doing so (Trebilcock, 1991). Understanding which incentives a legal regime gives its participants is a necessary precondition to judging its merits.

On the other hand, there is a normative, "judgmental" analysis, which indicates how rules should be configured to achieve the most wealth-maximizing outcome (Trebilcock, 1991). In this analysis, the concept of "efficiency" is of paramount importance: a law is efficient if it allocates resources in way in which their value is maximized (Posner, 2006). To determine whether a particular result is, in fact, wealth maximizing, an economic cost/benefit analysis is conducted, asking whether the beneficiaries of a certain rule could, hypothetical, compensate those that lose out from the change, and still have sufficient gains left for themselves (so-called "Kaldor-Hicks efficiency") (Note 6). It is important to note that, while many proponents of the theory observed that what constitutes a "benefit" to an individual can be virtually anything, this approach is preoccupied with determining the "value"

of a good by how much someone is willing to pay for it. Thus, in this analysis values only find a place where they can be expressed in monetary terms. As it will become clear in the following discussion, both modes of analysis produce valuable insights into the formalization of the ASM economy.

2.4 The Empirical Literature Study

Globally, a lot of concerns have been raised over artisanal and small-scale mining activities. The environmental cost of the activity is higher than those of large scale mining companies. The mining concerns produce negative impacts on the physical and social environment during various stages of mining; that is exploration, exploitation, processing and closure. The inability of large scale mining and agricultural industries to provide adequate employment opportunities for rural dwellers after main sources of livelihood: land and natural resources have been destroyed and are unproductive or taken for large scale mining activities has compelled many Tanzanians to pursue employment in ASM camps. The sector is viewed as the backbone of subsistence rural economy, after the agricultural sector as it provides employment for over thousands of youth and farmers.

In widely over million people depends on ASM to survive. The International Labor Organization (ILO) however estimate over 100 million people are indirectly employed and they are fully depends on it to earn their life, Bannock (n.d). The ASM for many decades have been using low technology and labor intensive to extract and process minerals. In Sub Saharan Africa (SSA) ASM have experiencing tremendous and rapid grow of the sector (Hilson & Hilson, 2015). The sector has rapidly grows for it has been shown the large ability to provide people with direct

employment and create an additional jobs (Barry, 1996; International Labor Organization (ILO), 1999). Different societies governed by different socio-cultural practice engage in ASM for instance in Guyana (rainforest belt) men leaves their farms and families to extract gold during the dry season, this is similar for gold mining in Suriname (Heemskerk, 2001, 2003). In Africa and Asia it is more commonly a family activity to observe Children and women participate directly in the mining, by carrying, processing and selling minerals as cited in Bugnosen (2001) for Philippines, Dreschler (2001) for South Africa and Hilson (2001) for Ghana.

In Tanzania, men mine while women and children carry the minerals out of the mines and process it. It is also common for women to sell the processed minerals in local markets (D' Souza, 2003). In Peru ASM operate in neighbor/countries around the mining site. The livelihoods of their member often rely solely on their mining capabilities, in some cases all members of the household participate in it. In some household women participate in supporting economic activities and in the case of home and children, it is usual for children to labor in the mines (Martinez, 1999; Kuramoto 2001). However in some societies a woman never enters mines due to strong cultural beliefs that this brings bad luck (Seeling, 2002). ASM has become an important livelihood for millions of otherwise unemployed people. In some country like Sierra Leone as sited in (Maconachie and Binns, 2007; Maconachie, 2012), Liberia (Van Bockstael, 2014), the DRC Congo (Geenen, 2013, 2014), Ghana (Hilson and Garforth, 2013), and Tanzania (Fisher, 2007), however Tanzania ASM it is termed as informal sector by the government (Dreschler, 2001). ASM have been employ greater number of the world's population (Table 2:1).

Table 2.1: Regional Spread of Employment in ASM

Region	Estimated employment in small scale mining
Africa	3.0 – 3.7 million
Asia/ Pacific	6.7 -7.2 million
Latin America	1.4 – 1.6 million
Developed country	0.4 – 0.5 million
Worldwide total	11.5 – 13 million

Source: International Labor Organization (1999)

In Ghana, it is in estimated that 30,000 people are employed within the formalized small scale mining (World Bank 1995). In developing countries ASM have proved to be the primary source of employment for job seekers from various parts of the countries who are relatively disadvantaged in labor, market such as unskilled, low skilled women, disabled etc).

According to Hillson (2003) who wrote that the majority of cases, artisanal and small-scale mining are poverty-driven activities that employ redundant large-scale mine laborers, seasonal farmers, and nomadic rural dwellers. Most of these individuals are low-skilled and poorly educated, and, as a result, earn subsistence wages. Moreover, the majority are subjected to working conditions that are by no means ideal, as most mine sites are surrounded by unsanitary waters and contaminated soils that contain a plethora of disease-carrying pathogens. Rosemary, *et al* (2004) wrote that that lack of official definition for ASM in Tanzania implies little recognition of the sector, despite extensive coverage in the Mining Act and Mining Policy of 1998. Chen (2012) finally wrote that a large share of ASM activity

now found in the region is largely poverty-driven reinforces the position of the Dualist school, which ‘sees the informal sector of the economy as comprising marginal activities…that provide income to the poor and a safety net in times of crisis’.

ASM in Tanzania is mainly based on high value minerals, especially gold and gemstones, it also include salt, limestone (aggregates and lime), kaolin and gypsum. As proven by a number of studies (Lwakatare, 1993; Chachage, 1995; Tan-Discovery, 1996) the sector has been a significant employer and largely labour intensive operations with greater impact on employment than large scale miners. Communities generate their livelihoods from the industry by engaging in direct mining activities and or by opening parallel auxiliary activities that benefit from the booming population in the area.

Water/river capital, notable environmental problems in the sector include chemical pollution for example cyanide, mercury and methyl mercury pollution, pollution of rivers and other water bodies through direct and indirect dumping of tailings and effluents, improperly constructed tailings dams (i.e. mine dumps), acid rock drainage, river siltation and damage in alluvial areas. The consequences of polluted water, land and soils can be seen in terms of bad health, lost agricultural productivity and damaged ecosystems (See Figure 2.2).

Land and soil capital, In comparison with agriculture or commercial forestry, mining is not generally an extensive form of land use. The impacts from artisanal mining on

land in particular include exploitation of bush meat, landscape destruction through pitting and heaping of sands, deforestation and destruction of forest reserves, cultural damage due to invasion of sensitive traditionally sacred areas such as grooves and other traditionally sacred places.

The hydrologic cycle describes the global flow of water to and from oceans, land, and atmosphere. Water moves by evaporation, precipitation, and runoff (Strahler, 2011)**.** Water cycle As the Sun warms the surface of the Earth, water rises from lakes, rivers, oceans, plants, the ground, and other sources. The vapor rises into the atmosphere, providing the moisture that forms clouds. It then returns to Earth in the form of rain, snow, sleet, and other form precipitation (Strahler & Metali, 2008) Soil moisture, atmosphere, streams and within life. Nearly 59 per cent of the water that falls on land returns to the atmosphere through evaporation from over the oceans as well as from other places. The remainder runs-off on the surface infiltrates into the ground or a part of it becomes glacier (Rajakumar, 2006). Also some water It fills lakes and wetlands, flows into rivers and oceans, and recharges underground water reserves. The process endlessly recycles the Earth's water (See Figure 2.1).

The impacts of the small scale mining is severe, the miners uses water from the streams unsustainably something that affects the cycle (Gusek & Fugueroa, 2009). Small scale miners cut down the tree which is the key catalyst facilitating transpiration, preservation of moisture and exchange water. The miners spill remains of chemicals like mercury to the streams and something that reduce their regenerative capacity (Buxton, 2013).

Table 2.2: The Role of ASM in Creation of Employment

No	Country	Total Number of Workers
1.	Bolivia	72,000
2.	Brazil	10,000
3.	Burkina faso	100,000 - 200,000
4.	Ecuador	92,000
5.	Ghana	200,000
6.	India	500,000
7.	Mali	200,000
8.	Mozambique	60,000
9.	Peru	30,000
10.	South Africa	10,000
11.	Tanzania	550,000
12.	Zambia	30,000
13.	Zimbabwe	350,000

Source: Hentschel, T., Hruschka, F., Priester, M. 2002

The impacts of the ASM on the environment affect water, land and forest resources which are vital resources to the general hydrological resources (Figure 2.1). Figure 2.1: Hydrologic Cycle Model, Water travels endlessly through the hydrosphere, atmosphere, lithosphere, and biosphere. The triangles show global average values as percentages. Note that all evaporation (86% _ 14% _ 100%) equals all precipitation (78% _ 22% _ 100%), and advection in the atmosphere is balanced by surface and subsurface water runoff when all of Earth is considered (1 km3 _ 0.24 _ 1 mi3).

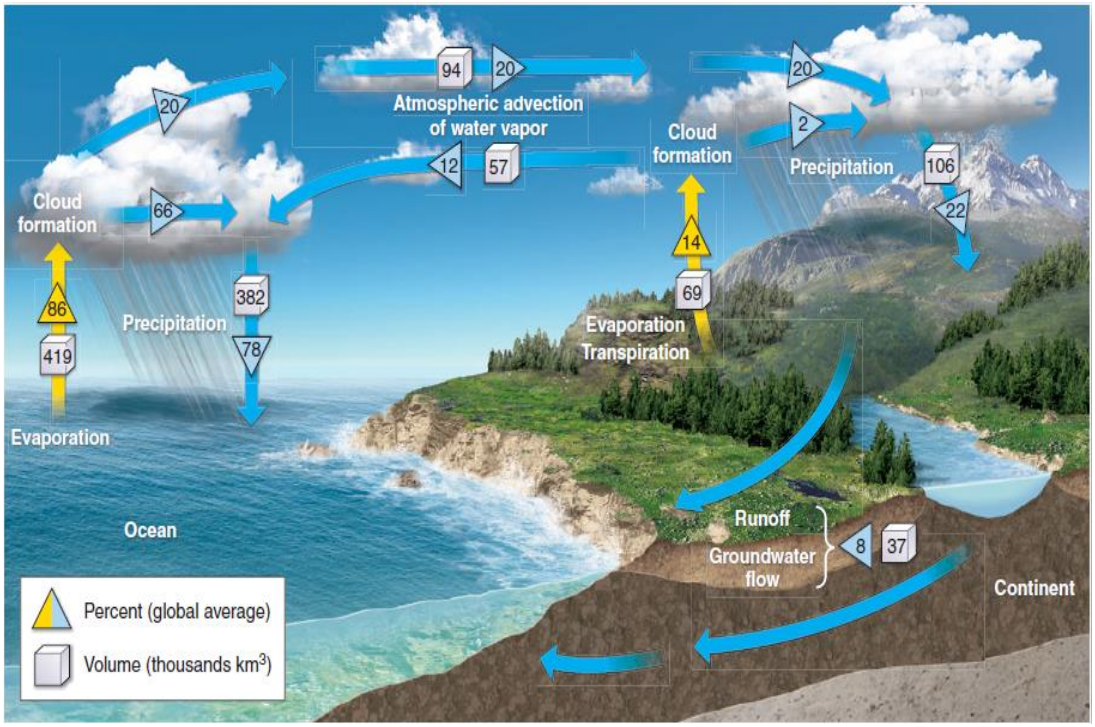


Figure 2.1: Hydrological Circle

Source: Christopherson (2012)

2.5 The Literature Review of Laws and Mining Policies

2.5.1 The Mining Policies and Acts

The 1997 National Mining Policy explicitly stipulates a framework for spurring the development and exploitation of minerals and a framework for foreseeing large and small-scale prospecting and mining sector; on the other hand, the mining Acts stipulate all legal issues governing mining operations in Tanzania. The ASM operates in illegal or informal style since it is not clearly stipulated in the mining policies. This study states that mining Acts in Tanzania only create a good environment for large-scale foreign investment than they do for artisanal mining operations. For instance, the Mining Act of 1998 impose a 100% foreign ownership of the mining industry, provide waivers for import duties on mining equipment including tax exemptions, and also impose low royalty of 3% for gold mineral based

on net back value (Bourgouin, 2011). Thanks for the 2010 Mining Act which imposes slightly higher royalty of 4% to be levied on the gross value of metallic minerals including gold.

The current study observes that increasing foreign investment in gold mining operations discourages labour intensive ASM. Some government officials have the notion that artisanal miners provide a window for stealing the gold mineral. This notion largely affects government's support to artisanal miners in terms of technologies used, licensing and marketing issues. On the other hand these perceptions give room for unsustainable mining that poses threat to the natural resources.

As reported elsewhere in Tanzania and in developing countries as a whole, large-scale mining has resulted into displacement of local people including artisanal miners. The artisanal miners who have been displaced from gold rich mining areas need policy and legal support to ensure that they work in partnership with large-scale mining companies in order to monitor the environmental friendly operations. One of the objectives of the 1997 Mineral Policy was alleviation of poverty especially on artisanal miners through transformation of the sub-sector by integrating artisanal mining into the rest of the economy. Transforming artisanal miners into more organized operations is the cornerstone of the 2009 mineral policy and the 2010 Mining Act. Simplified mineral trading licensing procedures and increasing number of licensed artisanal miners stipulated in the 2009 Policy document and in the 2010 Mining Act are all important in order to regularize and formalize artisanal and small-scale miners.

On the one hand, the artisanal miners believe they have rights as citizens to be mining the gemstone; also they believe investors should support locals to grow economically and socially. However there are difficulties in collecting revenue from artisanal miners and the government thinks investor is the best option for smooth proceeds gathering. The investor on the other hand, has legal rights to own and mine the gemstone, and support to artisanal miners and surrounding communities is not contractual; and therefore not legally binding.

2.6 Conceptual Framework

The research looks at the relationships between the ASM and natural resources management for sustainable development and livelihoods.

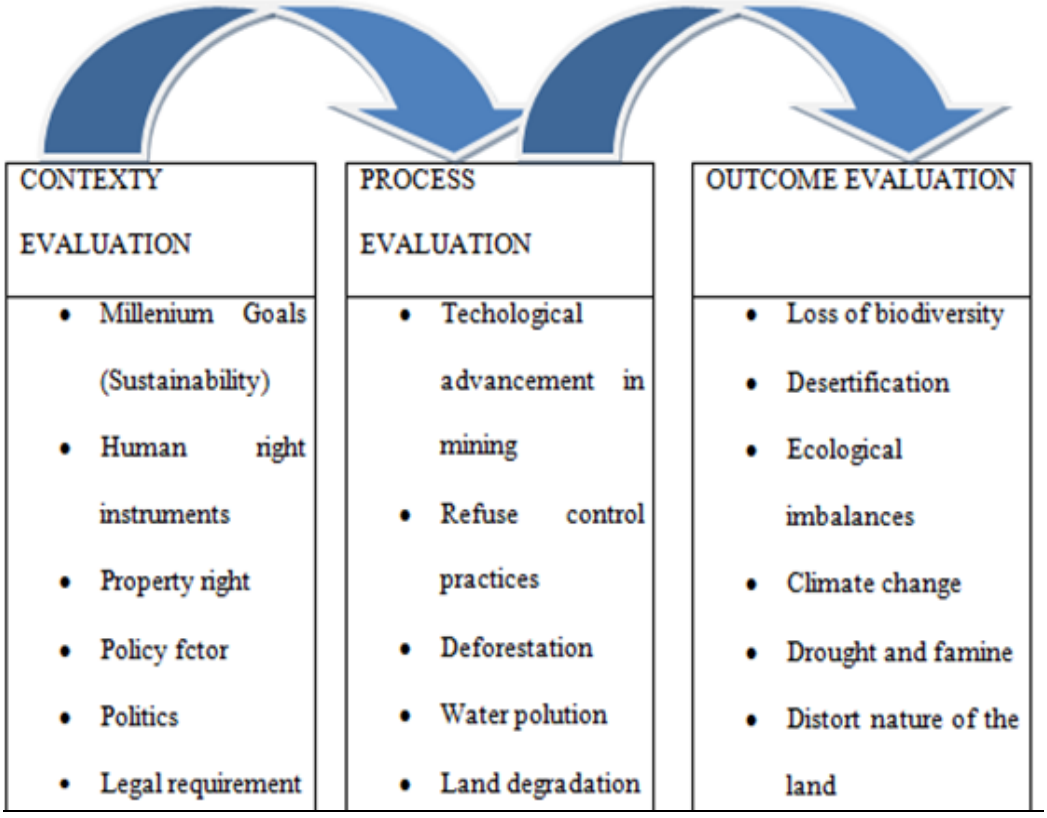


Figure 2.2: Diagrammatically Illustration on Conceptual Framework

Source: Tseng, K.H *et al.* (2010)

The fundamental premise of this framework is underpinned by the practical consequences of artisanal mining activities in mining communities and how the activities change people‘s livelihoods by creating capabilities that enable them cope with risks and shocks that may otherwise render them vulnerable. As much as the discussions and presentations on Artisanal Mining issues have been negative, there have been several benefits that have been documented. The basic realization is that the effects of Artisanal Mining activities affect individuals of communities in a multi - sectoral manner in both positive and negative ways.

2.7 Research Gap

The review show that most of the literatures have emphasizes much on the presence and the way artisanal mining are conducted. The managerial tasks like forecasting, planning, coordinating, commanding and organizing and controlling are wholly neglected where more concentration are posed on revenue collection and to the large scale mining. However, the first gap is that, very little emphasis has been said about how these artisanal miners can be assisted in terms of finance and technologies, which is the basic resource for its operations thus they may do their tasks effectively. Therefore, this study fills up these vacuums by presenting the means of getting control on a sustainable way in resources exploitation to make the mining operates effectively and efficiently. The main issue here is the sustainable exploitation of the resources and how to manage the artisanal miners who operates in remote areas.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This part provides the information on the area where the study was conducted. This part is mainly focusing on explaining how this study was conducted, the research approaches, research design; the part also shows the total sample and sampling techniques that were employed in the whole research and why was it preferred. The chapter also shows the data collection methods that were used and it also shows the methods that were used in the presentation of data collected in the field and the reasons as to why they were used, based on the objectives of the study and the nature of data gathered in the field. This part also provides the justification onto the selection of the data collection sites, justification and sources of data that was used in the study. This part also shows the analytical and statistical technique that was used in analyzing the data collected.

3.2 Research Design

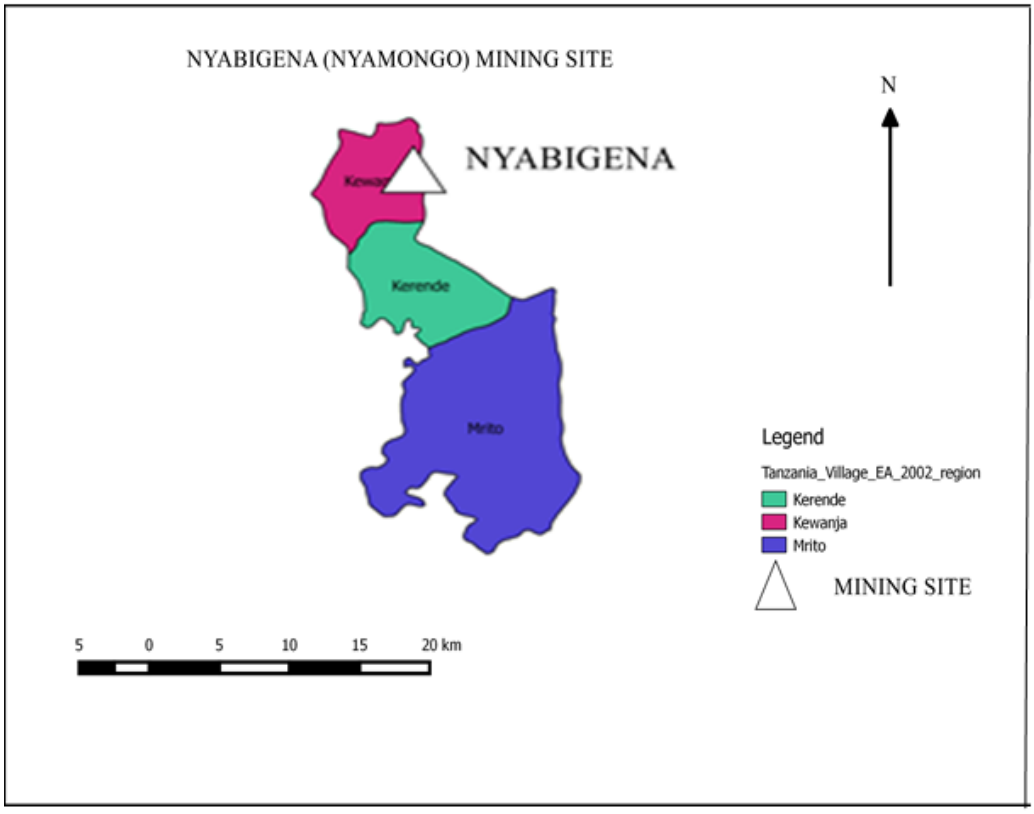
The study was conducted or completed under the foundation of the cross sectional and Quasi-experimental design. According to Enon (1998) cross sectional design allows data to be collected at once in a specific period of time with equal weight. This design helped in the collection of data in the field from different areas at different time and the compounded together. Quasi-experimental design was suitable because, William (2007) observed that this research design allows experimentation except it lacks key ingredient-randomization/random assignment on respondents. Also triangulation design was used as it is flexible and applicable in qualitative,

quantitative and mixed research approaches on a single unit to produce an in-depth description that is rich and holistic; this design allows the use of interview in data collection. Using the case study design it allows the use of multiple sources of data collection methods over time (Cohen et al 2007). The case study design was used for its flexibility since it allows the use of questionnaires, interview, field observation and secondary data sources in data collection.

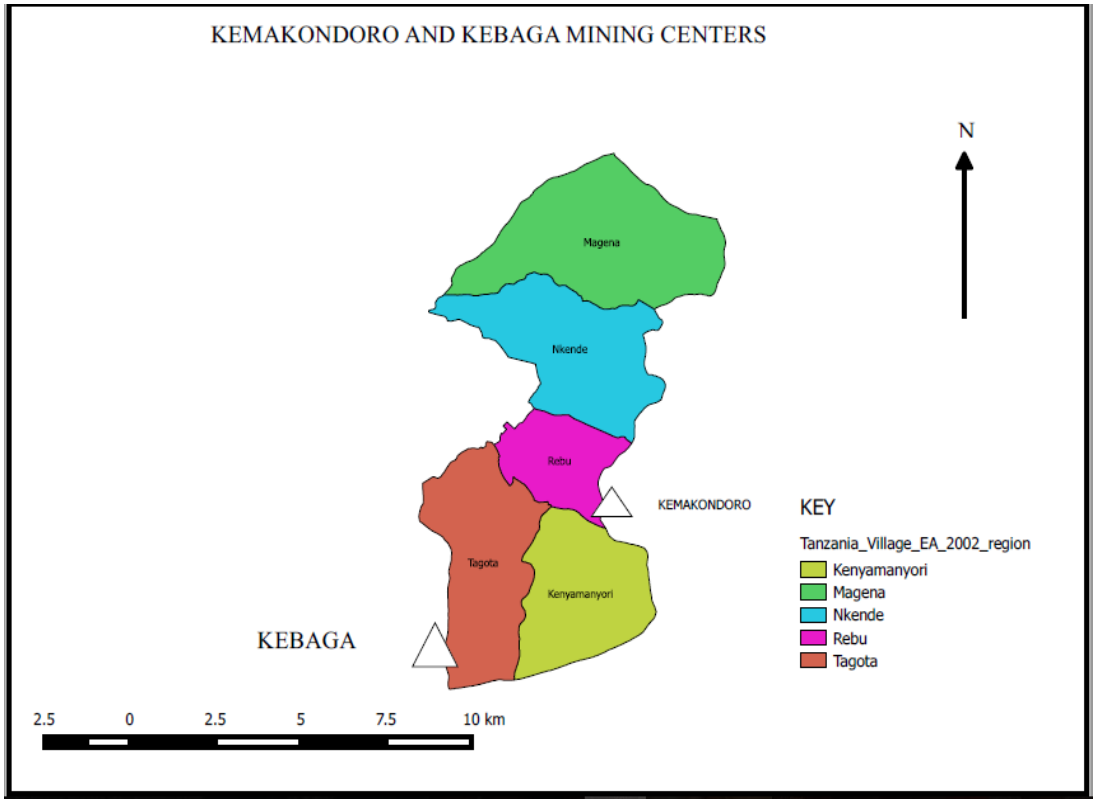
3.3 Area of the Study

The study was carried out in Tarime district in the mining camps of Kemakondoro, Kebaga and Nyabigena all located in the three Ward just situated east of Lake Victoria. Kemakondoro it is situated at $1^{0}23'09.1''$S and $34^{0}25'24.1''$ E with elevation of 1429.8 metres , Kebaga is situated at $1^{0}22'17.5''$S and $34^{0}24'24.3''$E with elevation of 1462.1 metres, while Nyabigena is situated at $1^{0}25'14.81''$S and $34^{0}33'52.95''$E with elevation of 1362.7 metres. This case study in Kemakondoro, Kibaga and Nyabigena artisanal gold operations were selected because are among many of the current mining operating countrywide without concessions from the government of Tanzania. The Kemakondoro, Kibaga and Nyabigena mining camps were chosen for this case for a number of reasons. In Mara Region alone there about 50 camps of the same kind but the selected one are situated in Mara River basin. The areas were rich in biodiversity, with favourable climate, fertile red soil, exceptional wetland with a number of natural springs and many small tributaries of the Mara River. The mining camps are one of the current areas surrounding the Nyamongo Barrick Gold Mine which has been leased out for mining activities by the Government of Tanzania in spite of reported cases of negative impacts of mining activities in the country. The

BAGMC is a MNC working in almost all eight continents of the world. Tarime District is one of the seven districts in Mara Region situated north, along the Tanzania Kenya boarder. From other districts it is separated by Mara River which originates in the forest of Mau Escarpment in Kenya and empties into Lake Victoria. Tarime District is endowed with a variety of natural resources such as land, rivers, forest, fertile soils, wildlife and minerals just to mention a few. The District has rich fertile reddish soil on which coffee, tea and bananas are cash crops and maize, cassava, potatoes and millet, with a favorable climate Tarime receives rainfall two times a year. Part of the district is occupied by Serengeti National Park which is a habitat of variety of flora and fauna; thus a hotbed of biodiversity.



Map 3.1: Map Nyabigena Mining Site



Map 3.2: Map Kemakondoro and Kebaga Mining Site

The selected study area was chosen because the current data on the assessment of impacts of artisanal mining on land, water and forest from Tarime district specifically in three mining areas show that the area are more and severely affected, and the other reasons are first, they are all located in rural areas where nearly 50 percents of households are miners (depends on mining) and the rest 50% are peasants depending on land for agriculture. The second, reason is the rapid urbanization in the centers that attract the in migration due to the growth of petty businesses and other mixed social recreational activities.

3.4 Targeted Population

Population formed a basis from which the sample of the study was drawn. During the study households were grouped into two groups, the first one are those

household whose daily livelihoods depend direct on mining (miners) or the Para-miner that is they provide services such as food, drinks and health amenities to the miners (treated group). The second population group are the communities living surround the mining camps but they are not involved in mining but are greatly affected by direct or indirect to mining activities (control group). However there will be a small administrative respondent which will include ward and village executives, the district mining and environmental officers.

According to the National Population and Housing Census (2012) household of Kemakondoro, Kibaga and Nyabigena were as follows 54, 102 and 185 respectively making a total of 341 households in the study area.

Table 3.1: Study Population

Mining camps	Households	Executives	District officers
Kemakondoro	54	3	4
Kebaga	102	3	
Nyabigena	185	3	

3.5 Sampling

This study uses probability and non-probability sampling techniques. In the probability technique simple random sampling was applied, in order to get the respondent households for data collection, analysis and interpretation. Simple random sampling was used to obtain samples whereby names of the heads of the household were written in pieces of papers, folded and mixed up in a box where three kindergarten children were asked to pick the required number from each camp

household. The selected names were used as representatives in the study. With a non-probability sampling, purposive sampling was used to obtain village and ward executives, mine/claims owners.

3.5.1 Sample Size

Heckathorn (2002) defines a sample size as the number of items to be selected from the universe to constitute a sample. It is the target group that must be of an optimum size that should be neither large nor too small so as to get statistical inference and also keeps the multi-stage or cluster sampling technique in a place. In order to determine the number of respondents needed for findings, computation was made by using the formula below

; nf =n/1 + (n)/N

Where nf = desired sample size, when study population is below 10,000

n = desired sample size, when the study population is above 10,000

N = estimate of the population size

The required inputs include, the total number mining community (households) and the no-mining community.

At least 50% of the total population (households) was randomly selected from three camps (villages) in group one and two that is 27, 51 and 93 from Kemakondoro, Kibaga and Nyabigena respectively.

(a) Phase one interview

The clear analysis of the population and sampling frame was done as follows;

Community level

85 interviews – male and female (miners and para-miners)

85 interviews – male and female (non miner/affected community)

170

Ward /villages executives =3 x 3 = 9

Elder at least 3@ = 9

Youth 3@ ward x 3 = 9

Total interviewers in phase one = 27 + 170 = 197

(b) Phase two Interview District level

District Environment Council 1

District Mineral officer 1

District Natural Resources officer 1

District land valuer 1

The total interviewers in phase two 4+197=201

The sample size was reasonable and large enough to justify the study because of their coverage being based on following qualities (Fisher, et al. 1983);

(a) It will consider the require precision of estimates to be produced

(b) The variability in different segments of the study population

(c) The size of the sample error had been reduced

(d) The size of the sample is large enough to allow valid analysis of the study area in Tarime District

3.5.2 Sampling Procedures

According to Saanane (2010), sampling procedure is referred to a set of ideas that specifies how the system calculate the sample size and contains information about

the evaluation of inspections of characteristics during results recording. In drawing sampling from the target population and also in order to ensure that the influences made about the population characteristics are accurate.

In this study the following stages was used for cluster sampling design when selecting respondents; first the total determine sample was distributed in proportional to the three intended study camps of Kemakondoro, Kebaga and Nyabigena where each camp was broken according to claims owners who will be sampled randomly from each camp; With respect to Kemakondoro the study randomly selected three claims. In case of Kebaga the study was work on five claims For Nyabigena seven claims were randomly selected.

Therefore, fifteen claims across in three wards which represent about thirty claims were surveyed. The second stage a list of working shift was identified under the shift leader. Finally with the help of each claim owner of the sampled claims they assisted the study to obtain a list of all eligible respondents who responded to the questionnaires.

3.5.3 Representatives of the Study Sample

The sampling frame which was developed for getting the sample was adhered to the statistical specification for accuracy and representativeness. The cluster sampling technique was used in this study to ensure that the same characteristics of the population represented the view that allowed a fair generalization of those findings to larger population over and above the procedures to minimize the sampling error (Ary, et al 2010).

3.5.4 Quantitative Sampling Techniques

The sampling technique was based on probability sampling, cluster and simple random technique was used. Simple random sampling was used to select the respondents from the sample size that comprises miners. Stratified sampling technique was used to get respondents from para-miners representing male and female in order to obtain heterogeneous population. With these strata simple random sampling techniques was applied to obtain the required representatives of the miners and non-miner that were to be constituted in a sample size (Cohen et al (2007).

3.5.5 Qualitative Sampling Techniques

The sampling technique based on no-probability sampling, purposive technique was used to select influential informants who are claim owners and wards executive officers were involved in the interview. This technique enabled the study to have relevant information from the respondents with special features, which was based on their status of being few in the study area (Ary, D et al 2010).

3.6 Data Collection

The data collection was done between June and August 2015 where the process was under the supervisor's assistance. Primary data was collected using questionnaires, interviews and observation. Secondary data was obtained from office records and various reports.

3.7 Piloting

Kothari (2004), this is a process of pre-testing the developed research instruments. It is very important to do piloting as it helps the study to check the clarity of the

instructions, sequencing and layout of issues, feedback of validity of concepts and constructs used to eliminate ambiguous of all difficult terms and words, check the time it took to complete the exercise and to identify the redundant questions or instructions. Two claims (holes) are to be involved, where two claim owner and 20 miners and 3 informants were involved too.

3.7.1 Primary Data

(i) Questionnaires

Jamal & Kamzola (2008) defined a questionnaire as a set of written questions that are either given to respondents to complete or are posted to them. According to Kothari (2004), respondents have to answer the questions on their own time might be open-ended or closed-ended. Open-ended questions are often designed to allow respondents to give their own answers, while close-ended questions are designed to give specific and definite answers such as Yes or No. This study employed closed-ended and open-ended questions to obtain information. Furthermore, according to Fisher et al. (1983), the open ended questions allow respondents to provide freely necessary information. This method was used to collect information related to the effects of artisanal miners to the water, land and forest resources. Also the method was used to collect the information related to measures taken by the artisanal miners to sustain their life on their degraded land.

(ii) Interview

The interview is the face-to-face interaction between the researcher and the respondents. Interviews are of the three types, namely, structured, semi-structured and unstructured. Cohen et al (2007) observed that structured interviews contains

pre-set questions that were asked in the same every time, whereas semi-structured interview is a mixture of structure and unstructured interview questions such that questions might be predetermined but the interview might feel free to deviate from those questions so as to explore issues raised by answer. Unstructured interview resemble with conversations rather than the tightly structured interview schedule. The purpose of unstructured interview was used gain an in depth understanding of interviews, perception of particular objects or issues putting into consideration those individuals who have unique ways of defining their world. This study uses both semi-structured in getting data from informants while questionnaires are made to get data from respondents. Interview method was used to gather information on the nature of the miners, methods used, copying mechanism and problems facing miners during the mining activities.

(iii) Observation

With observation methods, the information was sought by the way of investigating direct observation without asking the respondents (Kothari 2004). The researcher used participant observation method by eye witnessing the impact of artisanal mining on natural resources particularly water, land and forest/vegetation. The method is of importance to the researcher since it eliminates biasness from respondents.

3.7.2 Secondary Data

A lot of data was obtained from office records, and reports. The documentary reviews was involved analyzing contents of documentary materials such as books magazines, newspapers and content of all other verbal materials, which were other

spoken or printed (Kombo & Tromp, 2006). Documentary reviews were used as a complement on the field data. This study utilized and analyzed non-verbal materials pertaining to the assessment of impact of artisanal mining on natural resources to be obtained from the survey in Tarime district and the related responsible offices.

Indeed this study analyzed by sorting relevant views from different scholars in relation to the assessment of the impacts of artisanal mining across Tarime district with acknowledgement. Documentary review basically provided secondary data for the study which that helped to avoid repetitions of academic studies by identifying an appropriate research gap that would be filled by study mainly strategies of helping and save the natural resources from excessive deterioration. This method was used to reviews different statistical data so as to enrich the study with plenty of information.

3.8 Validity and Reliability

Anderson (1979) validity means the most critical criterion that indicates the degree to which an instrument measures what is supposed to measure, also Anderson (1979) defines reliability which means the capacity to measure to produce a set of observations of a stable universe. In other words, validation is the process of verifying correctness of research instruments to be used in collecting data, whereas reliability applies the measurement of tools that will be used in collecting data. However, in checking validity and reliability of research tools, this study applied multiple data collection methods namely, interviews, questionnaire, observation and documentary review. Besides, this study consulted the supervisor so as to verify

accuracy of research instruments. In addition to that the pilot testing of the research instrument was conducted whereby two claims are to be involved.

3.9 Data Analysis

Anderson (1979), data analysis involved a number of closely related operations, which performed with the purpose of summarizing the collected data and organizing them in such manner that they answered the research questions.

In respect with qualitative data, this study recorded in a notebook, analyzed and interpreted by using summaries, explanation, and descriptions. Qualitative data to be collected was subjected to content analysis, and in many cases respondents' actual words were reported, qualitative data was used to support quantitative data while content analysis are examined the intensity with which certain words were used. Kombo & Tromp (2006). It systematically describes the form or content of written and or spoken materials.

On the other hand Kothari (2008), quantitative data gathered from miners by using questionnaire were cleaned, edited, coded and entered in computer software using a SPSS. This will generate descriptive statistics such as percentages and averages. Cross tabulations using SPSS software was applied to determine the degree of association between various variables. Also Microsoft excel was used to plot some tables, chart and figures. Since the information was accompanied with different statistical data. The information collected was presented using suitable tools such as bar graph, tables and pie charts since they are suitable methods of presenting data.

3.10 Ethical Implications

Cohen et al. (2007) assert that it involved norms for conducting research that distinguish between acceptable and unacceptable behaviors, the most common ways of defining it, is that it included rules for distinguishing between wrong and right.

The study protected the informants from any kind of harm being psychological, social or physical as they participated. Therefore, the study adhered to this principle together with other ethical principles like confidentiality, anonymity, objectivity, and ensuring informed consent. Confidentiality was highly maintained, the privacy of the information that was provided or collected in the study. Anonymity was also considered. In informed consent the informant was well informed of their fully participation in the study. Therefore in this study the ethical issues were addressed highly adhered to.

The study requested permission to conduct research from the Open University of Tanzania where the permission was granted. In the same way the study asked Tarime District Mineral resource officer and the targeted WEO for permission to conduct the study and the permission was granted. Through the wards executives the claim owner was also informed over the intended study for their cooperation. This study also explained the reasons for conducting the study to the correspondents and sought for the consent so as to ensure them confidentiality of the expected information. The researcher obtained the information from the respondents voluntarily. Therefore all sources of information that was cited by the researcher the names of the respondent was not are revealed in the study.

3.11 Limitation of the Study

During the research process (Data collection) the study faced the following problems:

Since the study was conducted in the interior in a typical ignorant society, most of the respondents were running away from the researcher soon after seeing paper and pen he held despite the fact that respondents had been informed before. Many of the respondents from questionnaire and interview were poorly understood the questions, hence did not well answered and it was influenced by low level of education, to solve this problem the researcher widens their understanding by code mixing and code switching to their mother tongue (language).

Both interview and questionnaires hide some of information for protection of the mining sites from being closed, for instance children were not mention as being involved in mining while it was observed that they are also involved in ASM, also the respondent denied to be affecting the environment.

Furthermore, most of the respondents were busy doing their work, hence they did not fully participated in provision the necessary required information. There was the problem of insecurity as most of the respondent during the interview they were always carries Panga (Big knife) local weapons while smoking marijuana. Also most of the respondents demanded money in an exchange for information required by the research which is totally against the research ethics.

CHAPTER FOUR

RESEARCH DISCUSSION OF THE FINDINGS RESULSTS

4.1 Introduction

This chapter presents the discussions of the study findings conducted in Tarime District at Kemakondoro, Kibaga and Nyabigena Wards. The first section presents the general information of the respondents of this study, which includes; gender, age, education level and place of birth. The second section examines the respondent's types of daily activities, the awareness of natural/environmental resources effects, and the effects of artisanal mining to water capital. The third section tries to explore the effects of artisanal mining on the land resource. The fourth section examines the effects of mining on forest/vegetation, the fifth section tries to find out the the adaption and coping mechanisms of the surrounding communities to the impacts of Artisanal mining on land, water and forest. Finally the section is basing on discussion of the results from the findings.

4.2 General Characteristics of Respondents

The comparative characteristics of the affected communities that is the miners and the non-miners communities were investigated by looking their general characteristics of the respondents which are age, gender, education and their effects of ASM on natural resources water, land and forest. The findings show that 154 respondents were interviewed which is equal to 90%, they do engage in ASM annually and 120 respondents which is equal to 70% states that ASM is their main/ major source of income (See Table 4.1). In these mining areas it was observed that male, female and children who legally are not allowed are also working there,

however the respondents from both interviews and questionnaire responded negatively that children are not involved in ASM while it was observed that they participate in both digging gold, carrying sand from the pits and holes to washing site and washing sand. Findings show in every household at least seven (7) members (male and female) are engaging in ASM, excluding children.

4.3 Major Natural Resources that are Affected and Threatened by ASM Activities

The data collected from questionnaire respondents, interview and observation checklist in the field indicated the following resources to be affected by the ASM activities.

4.3.1 Land Resource

The finding indicates that 260 of 373 which are equal to 69% of the questionnaire respondents indicated that land resources are more affected by these ASM activities. Land resources that are affected are very fertile and arable for agricultural activities. Also 100% of the 373 questionnaire respondents identified that after mineral extraction the land cannot be used for agriculture activities, see figure 4.1. Also 99.1% of 30 respondents identified that the land after mining activities are not operating sustainably, similarly 50% of 30 respondents identified that the land cannot be used again once gold is extracted as the land remains with plenty of pits, holes and underground tunnel. Also 136 of interviewee which is equal to 80% and the interview conducted with 8 owners of mining ground responded positively that land are massively destructed and degraded due to mining extracted from the land (See plates 4.1, 4.6 and 4.8., and Figure 4.1).

Table 4.1: The major income sources, many people depend on ASM although this activity is not done sustainably. Hence the government should improve the mining extraction processes so as reduce their impacts on the environment.

From the findings land resources are more affected by the ASM that it turns into pits, holes and contaminated land with mercury. It was supported by 253 of the 373 questionnaire respondents which are equal to 65.7%, while 373 of the 373 questionnaire respondents which are equal to 100% commented that land cannot be used again for agriculture, similarly 15 out of the 30 which is equal to 50% of respondent and 136 of 170 accounting 80% of interviewed respondents. It is also supported by a study of Hardin (1968), which indicated that the massive exploitation of resources is done without reflecting on their impacts on the environment. Also Garvin et al (2009) wrote that the ASM activities have affected the farmland of the thousand local communities. The survey data and the literatures have clearly indicated how much the land resources are affected, the land resources that are fertile and arable land have turned into pits, holes and contaminated land with wasteful chemical.

Table 4.1: The Major Income Sources

	Frequency	Percent	Valid Percent	Cumulative Percent
Agriculture and Animal keeping	55	14.7	14.7	14.7
Small scale miners	318	85.3	85.3	100.0
Total	373	100.0	100.0	

Source: Survey Data

Plate 4.1: Land Filled with Rocks from Pits and Holes
Source: Field Data (2015)

4.3.2 Water Resources

Field data shows that water resources are severed affected by the ASM. It was observed that sand that is perceived to have gold all the time is washed by mercury as in Kebaga mining and in some area without mercury as in Kemakondoro mining. About 96 of the 373 respondents which is equal to 25.7% who were miners stated that their activities of extracting minerals from the ground to the large extent affect water resources. Also 270 of the 373 questionnaire respondents which is equal to 74.3 stated that their villages have the plenty of water but are too dirty and 360 of the 373 questionnaire respondents which is equal to 96.4% commented that water that are dirty have been polluted by the ASM when washing gold mixed with mercury. Also 26 respondents out of 30 which is equal to 86.5% of respondents revealed.

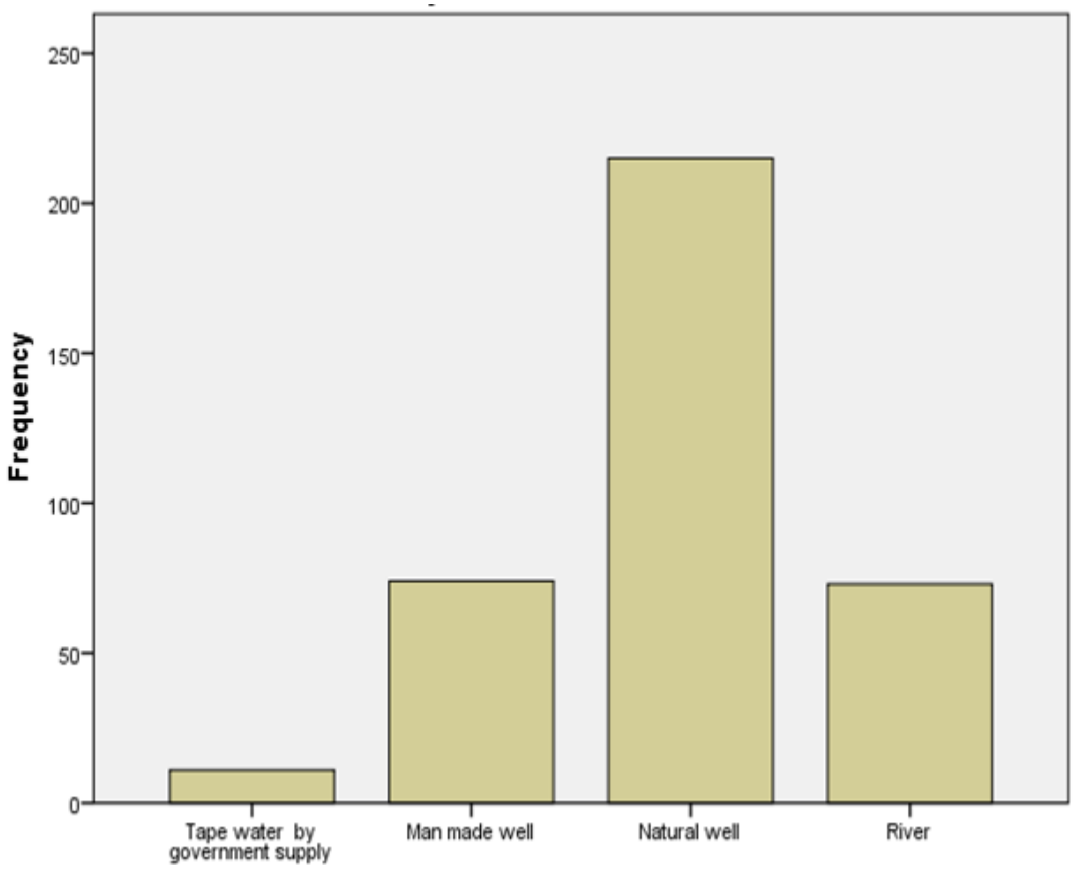


Figure 4.1: The most Reliable Source of Water as Supported by Interview and Questionnaire Respondents

It was revealed. The natural well as their main sources of water believed to be contaminated and polluted by mercury. Furthermore, it was revealed by 373 questionnaire respondents, which are equal to 100% that water is a crucial washing material for gold extraction process in ASM activities when mixing it with mercury. Furthermore, the interview conducted between 3 three shaft owners (mine owner) and other employed workers revealed that mercury is very important in gold processing when mixed with sand, however they said that mercury cannot be used alone it is mixed with water, this makes water from rivers to be severely affected by these artisanal activities and become vulnerable to this activities, See Figure 4.1 and compare Plates 4.2, 4.3 and 4.4.

Plate 4.2: Water Resource at Kemakondoro before Reaching the ASM Areas
Source: Field data (2015)

Many ASM wash their gold sand using mercury without any water protection, preservation, conservation measures as in Kemakondoro and Nyabigena, for instance 96 of the 373 questionnaire respondents which are equal to 25.7% stated that the whole gold processing affects water; similarly 360 of the 373 questionnaire respondents which are equal to 96.5% supported that water streams are dirty and have been polluted by ASM activities. Also 26 out of 30 respondents which is equal to 86.6% admitted that water are polluted during their works. Also the interview conducted revealed as ASM to be the source of water pollution through mercury contamination during amalgamation process, it was observed that silts and mud also flows to the stream during the amalgamation processes.

This finding is supported by Hardin (1968) who wrote that the artisanal mining threats water bodies where they process their ores in as common-property resources

and they are mindless of polluting them. They expose mercury into the environment with impurity without any action to reclaim the land leading to the diseases which affect the whole society. Philemon (2009) wrote that lack of skills and modern technology have been cited as key factors that hamper small scale gemstone mining in Tanzania in produce high quality minerals. Action Aid Ghana (2006) wrote that land resources under cultivation in ASM have been contaminated through gold mining activities and toxic water pollution this have affected food security in operational areas. Kigwangallah (2009) wrote that gender activists have voiced concern on the plight of people living in gold mining areas, saying their future is depressing due to environmental pollution caused by chemicals, See Figure 5.1. Many ASM and neighboring communities have been affected by water and noise pollution. In this context education through intensive training is much needed together with technical assistance to enhance sustainable mineral extraction and processing activities in a sustainable manner.

Plate 4.3: Water after being Polluted by the ASM Activities, Leading to Reduction of Food Supply and Production

Source: Field Data (2015)

 :

Plate 4.4: Polluted Water at Kemakondoro Mining Area
Source: Field Data (2015)

4.3.3 Forest Resources

Being the common energy/fuel resource surrounding the small scale mining residence, they are also prone to the impacts of artisanal small scale miners. About 32 of the 373 questionnaire respondents which is equal to 8.4% of the respondents pointed out that forest resource are severely affected, similarly the same percentage stated that prior the beginning of the mining activities the whole land were covered by forest but thereafter vast of land were cleared and burned. Geographically deforestation reduces the amount of precipitation annually leading to the so called global climatic change, (See Figure 4.3). Also 169 0f the 170 which is equal to 99.4% of interviewed respondents stated that they are depended on fuel wood as a main source of energy for their domestic use. It was observed by 24 respondents out of 30 which is equal to 80% that much of the forest resources are affected by the ASM, similarly 26 out of 30 of respondents which is equal to 86.6% shows that

there is high rate of land degradation and forest deforestation and stagnation as a result of divergence of water from the stream, contamination of river stream from mercury, deposition of silt and mud during the mining process. The impacts of these artisanal miners on the forest resources are high and call for immediate and emergence measures to rescue land and human resources (See Plate 4.5 and Figure 4.3).

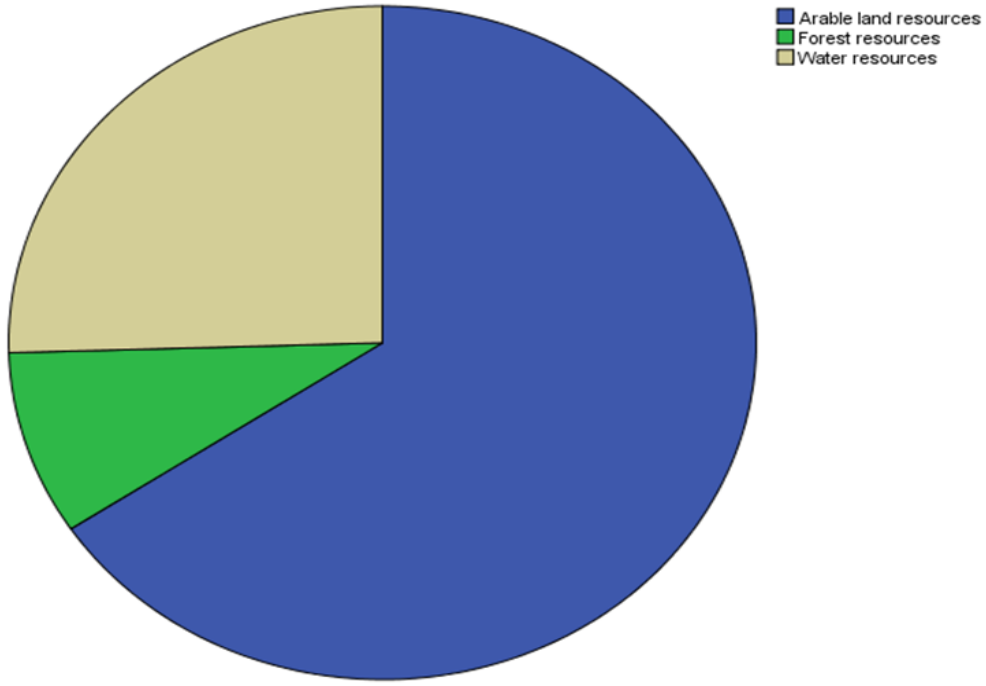


Figure 4.2: The Major Resources that are affected by the ASM Activities

Source: Field data (2015)

The field data show most of forest resources surrounding the ASM activities have been affected. This finding is highly supported by Hinton (2002) who wrote that deforestation can significantly affects women and their families due to the importance of the forest resources for fuel wood, building materials, traditional medicines. Hilson (2003) wrote that loss of natural resources leads to shortage of firewood supply, reduced forest and bushes and its effects on ethno-botany

(Traditional herbalist**).** Plants in its nature plays the role in of the earth resources like land conservation, and protection of earth from erosion, and Hydrological cycle.

Plate 4.5: Prior to the Commencement of Mining Activities at Kemakondoro, where this Fertile Land is Perceived to have Minerals
Source: Field data (2015)

Plate 4.6: Massive Land Degradation by ASM
Source: Mgamba (2010)

Generally, according to ESM there is a high integration, interdependence and relation between Hydrosphere, Atmosphere, Lithosphere (Crust) and Biosphere. The distortions of one element in the system destabilize the general earth ecosystem (Figure 4.2).

4.4 The Effects of ASM on the Land, Water and Forest Resources

The common environmental impacts caused by artisanal mining include diversion of rivers, water siltation, landscape degradation, deforestation, destruction of aquatic life habitat, and widespread mercury pollution. Since amalgamation is simple, inexpensive and does not require skilled labor, it is the gold concentration method mostly used by local miners. The process employs metallic mercury to trap fine gold from ore pulp.

4.4.1 Land Surface Destruction

It was observed that most of the land covered with mineral (Gold) are left with holes, and pits, despite the fact that they are dangerous. About 29 out of 30 respondents which is equal to 95% revealed that mining activities are not done friendly to the environment, for instance methods of extraction at Nyabigena and Kebaga are similar to that of Kemakondoro except that at Kemakondoro have shallow pits and holes, while that of Kebaga and Nyabigena have deep and in some area underground tunnel with measurement of 100 feet and above. The mining owner proved that they use explosives and blasting, while drilling holes of approximately a width of 2-10 meters (Plate 4.8, Plate 4.9 and Plate 4.10). Further observation showed that after mineral extraction all pits and holes on the surface are left open leaving the landscape dangerous to human and other animals and

unrehabilitable (Plate 4.9). Furthermore, 128 of the 170 respondents which is equal to 75.2% of neighboring interviewed respondents stated that these explosives have caused conflicts that led to cracking of houses, while 373 of the 373 questionnaire respondents which is equal to 100% commented that the land cannot be used again as are full of pits, hole and rocks or gravel. It also observed that prior the mineral extraction the land are always forested, arable and fertile capable of supporting tea, coffee, banana and other food and cash crops (See Plate 4.13).

Plate 4.7: Massive Degradation of Surface Landscape
Source: Field Data (2015)

Mwami et al (2002) who wrote that land surface degradation and deforestation are normal and natural consequences, the use of explosives leaves the holes and weakens the settlement leading to conflicts, also Hilson (2003) wrote that ASM activities have lead to creation of new settlements cause mass degradation of natural resources like land and vegetation. Similarly Garvin et al (2009) commented that the activities of ASM have affected the farmland of thousand of local communities. According to Action Aid Ghana (2006) large areas of land previously under

cultivation are believed to have been contaminated by gold mining activities and toxic water pollution.

Plate 4.8: Show the Artisanal Small Scale Miner Digging Sand to Processes Gold Making the Land un-useful for Agriculture Production

Source: Field Data (2015)

Plate 4.9: Abandoned Inactive Mine Pits at Nyarugusu Mining Site

Source: Kitula (2006)

Plate 4.10: The Local Made Tool for Grinding Rock which is used by Few who Afford while those who Afford while those who do not Afford the Grind by using Hummer Hitting against the Rock Bared

Source: Survey Data (2015)

4.4.2 Land Pollution

The field data shows that 81 miners which are equal to 95% stated that these mining are using mercury to process gold from sand. The interview conducted to the Shaft owners and 339 of the 373 questionnaire respondents which are equal to 90% responded positively that mercury which are sold by quarters (Buyers) as a key ingredients to gold processing after extraction, see plate 4.10 and Plate 5.1. Furthermore 29 out of 30 which are equal to 99.6% of respondents show that land resource is not used sustainably. Also the interview conducted with women who

involves in washing gold sand with mercury proves that all women are using mercury with their bare hand and without any protection to process gold, See Table 4.2. Furthermore 339 of the 373 questionnaire.

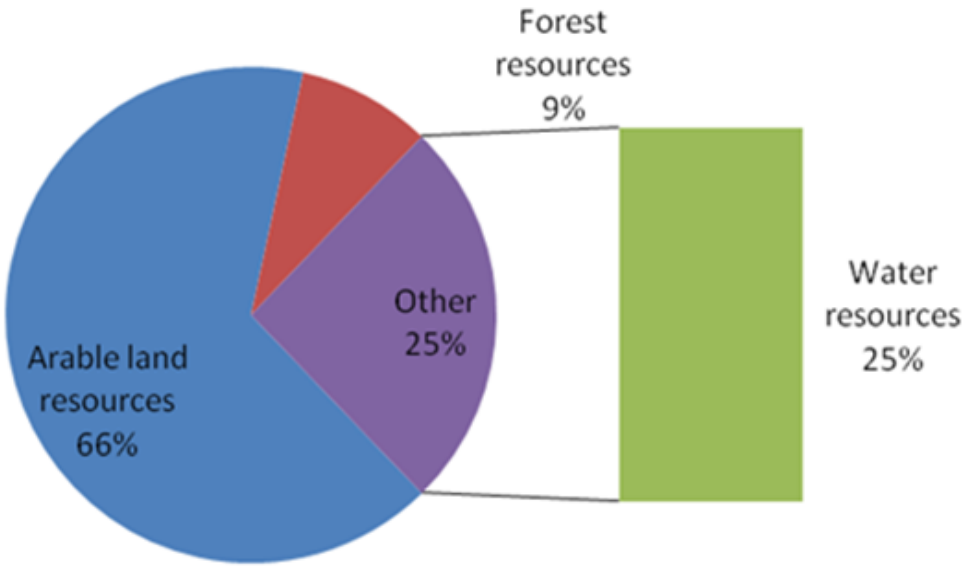


Figure 4.3: The Resources that are Severed affected by the ASM
Source: Field Survey

Respondents which are equal to 90% said that miners dig pits to test for the existence of gold. If there is not enough gold and the mining venture appears to be unprofitable, the pits are abandoned without being filled. The result is that the area is covered with pits of various depths from two to 20 meters that are left unattended. These pits are sometimes death traps for domestic animals and people walking in the area at night or during the wet season when the pits are covered by grass. It was observed that after getting gold from sand they pour it on land surfaces leaving it contaminate the land surface as supported by all questionnaire respondents. These chemicals heavy metal turn land into harmful, hazardous and dangerous for cultivation and weakens its ability to support food production, see Plate 4.12, Plate 4.17 and Plate 4.18.

Plate 4.11: Polluted Land Hinders Agriculture Production Leads to Drying of Food Crops like Banana, Cassava and Maize

Source: Field Data (2015)

Field data indicates that the land is highly affected by contamination of heavy metals like mercury. This finding is supported by Rukonge (2006) who observed that land degradation and pollution on the same time accelerates drought, fertility depletion and low agricultural production in rural Tanzania. Also Armah et al (2010) observed that poor mineral mining operation in Ghana leads to environmental pollution. Sustainably improper disposal of industrial waste and pollution from chemicals such as mercury and cyanide presents an impact on the livelihoods of the whole community as well as regulators.

4.4.3 Water Pollution

It was observed in few gold mines those miners are able to extract gold with water only as in Kemakondoro through the flowing river streams this turns water from colorless state into reddish in color and deposition of washed sand onto the river stream reducing its natural flow. It was observed that all women at Kebaga mine

wash their gold sand with mercury which joins the river streams through underground penetration by percolating and infiltration, this leads to contamination of water with mercury, See Plate 4.13 and Figure 4.3.

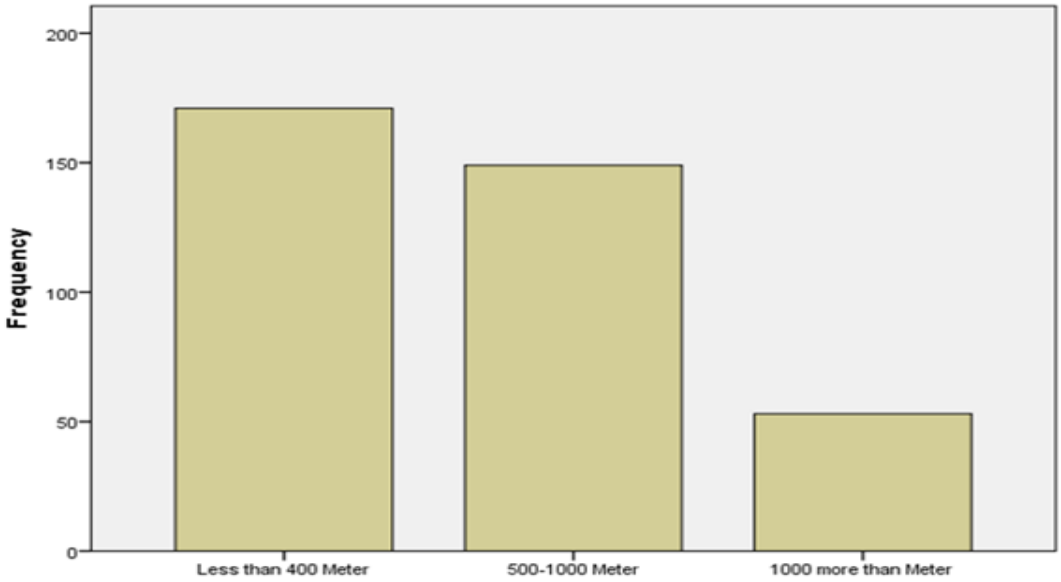


Figure 4.4: Shows the Distance Spent by the Community Member to Fetch Water for the Domestic uses

It was observed that many neighboring communities have water nearby their homestead though they don't utilizes for they have been polluted by the ASM.

Plate 4.12: Washing trough shows Water Contaminated with Mercury which Percolate and Infiltrate Deep Underground, which Joins to Streams of River at Kebaga

Table 4.2: Women's Participation in Small-Scale Mining in Tanzania

Commodity	Direct	Indirect	Total
Gold	8,400	41,810	50,216
Diamond	523	503	1,028
Gemstone	17,866	56,430	74,296
Salt	9,876	7,585	17,464
Aggregates	14	37	62
Dimension stones	9,920	7,699	17,619
Grand total	**46,599**	**144,066**	**160,685**

Source: Dreschler (2001)

Plate 4.13: Women Mixing Gold Sand with Water and Mercury by Hand Free from any Protection

Source. Field Data (2015)

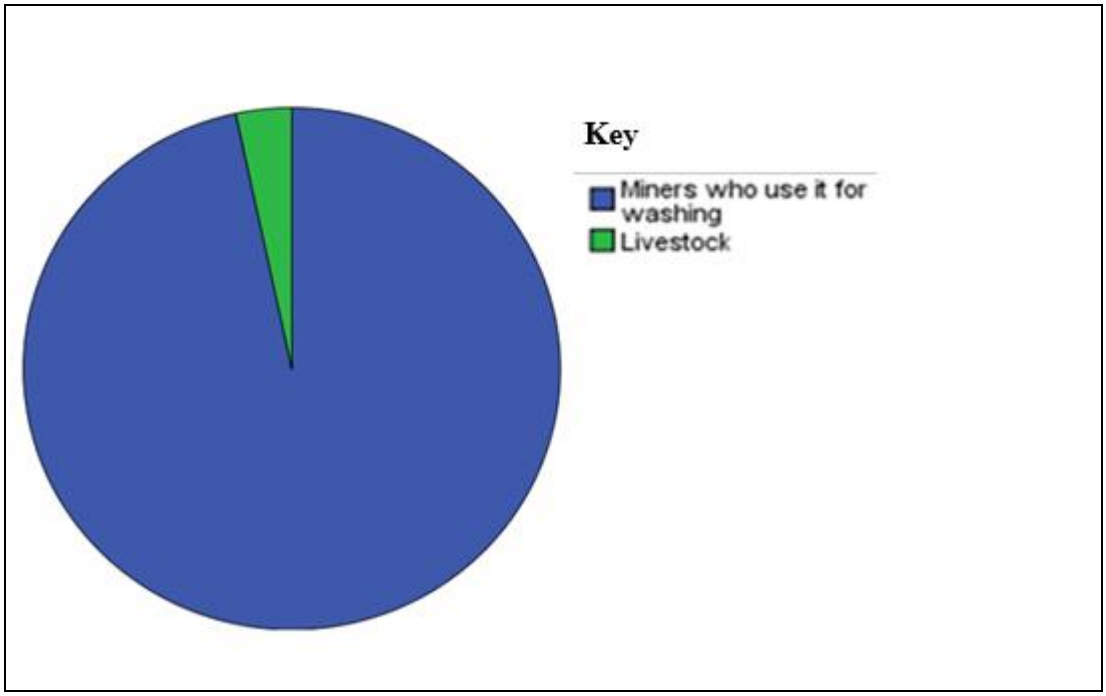


Figure 4.5: Shows the Majority of respondents stated that Domestic Water has been Polluted by the ASM During the Process of Processing Gold

Source: Field data (2015)

Plate 4.14: Women Mixing Gold Sand Mixed with Water and Mercury with Bare Hand, while Water Flows Down the Valley following the Streams at Kebaga

Source: Field Data (2015)

The interview conducted revealed that water pollution is caused by poor technology/tools used, lack of education on the impacts of mercury to the human species, aquatic and biological diversity. This finding is supported by Veiga & Beinhoff, (1997); McMahon et al, 1999; Mwami et al (2002); Akabzaa & Yidana, (2011); Ahorbo, (2014) who observed that most of ASM wash their grinded rock along the river, streams, pond, catchment areas, springs and other water bodies.

The mixing of cyanide with water could be deadly to aquatic and human life. The user of river water at lower valley unknowingly and ignorantly utilizes the polluted water for domestic uses. Scientific researchers have propagated the impact of mercury metal to women especially pregnant one; the contamination of this heavy metal with water can harm human species leading to diseases and weakens the body immune system, see Plate 5.2.

Plate 4.15: Chacha Mwita an Artisanal Miner at Ikungi Mines in Butiama District, Mara Region Extracts Gold from Muddy Water Believed to be Contaminated with Mercury

Source: Ng`hily (2013)

Also Philemon (2010) wrote the ASM is the source of Tuberculosis TB and the technical team was formed in an effort to combat tuberculosis in the mining sector, where the disease is reported to be incubated at high rates.

It was observed that most of miners do not have large compressors/water pump as these tools are very expensive hence they diverge dirty water to the streams of water. The interview conducted with respondents responded that there were no pumps observed on site. Therefore, water is removed from the pits by using a bucket and a rope. A bucket is manually filled with water at the bottom of the pit and then hoisted to surface for disposal. Given the topography and the fact that some pits are located in abandoned quarries, the disposed-off water may find its way underground again. About 29 out of 30 respondents which are equal to 99.6% shows that the mining processes are not done sustainably, and all questionnaire and interview respondents said that this scene is caused by poor technology and limited education on the impacts of their activities on the environment and in the coming future.

Plate 4.16: Polluted River by ASM at Kemakondoro
Source: Field Data (2015)

4.4.4 Drying of Rivers and Streams

Water resources are severely affected and vulnerable to the activities of ASM, for example Kemakondoro mining are located along the river stream, the activities of ASM results to changes in river regime and ecology due to siltation and flow modification. Also Kebaga mining which has been operating since 1970's or from dates back by drilling rocks as revealed by mining owners during interview and using explosives which have been the main causes of alteration in water table, also the activities of washing sand along the river stream at Kemakondoro is highly altered from sediments run off from washed sand. The deposition of sand at the center of river stream lead to the spreads of water increasing the rate of evaporation leads to the dry of water stream. The drying of water alters the whole ecosystem as many people are depended on these streams of water, See Figure 4.5.

4.4.5 Deforestation

It was found that most of forested land have been cleared forests leaving the land bare for mineral extraction, also the forest around the mine areas have been cleared and transported to the mining areas for making structures for mineral extraction. During the interview with the neighboring respondents at Kebaga and Kemakondoro revealed that prior mining activities the whole area were covered by forest and the area was covered forest and the forest was cleared following the discovery of gold mineral. About 264 of the 373 questionnaire respondents which are equal to 70.7% of questionnaire respondents said that the addition to chemical contamination, artisanal mining can detrimentally impact ecosystems through deforestation and the modifications of hydrologic systems. Also 169 out of 170 interviewed respondents

which are 99.3% revealed that many women are depended on fuel wood as a major source of energy. Women, as the ones primarily responsible for fuel wood collection and for using forests for food and medicine in many ASM areas, may be more affected by changes in the availability of firewood, food, and medicinal plants. Clear-cutting forests (deforestation) can significantly impact women and families, due to the importance of forests for fuel wood and, sometimes, food and medicine, See Figure 4.7.

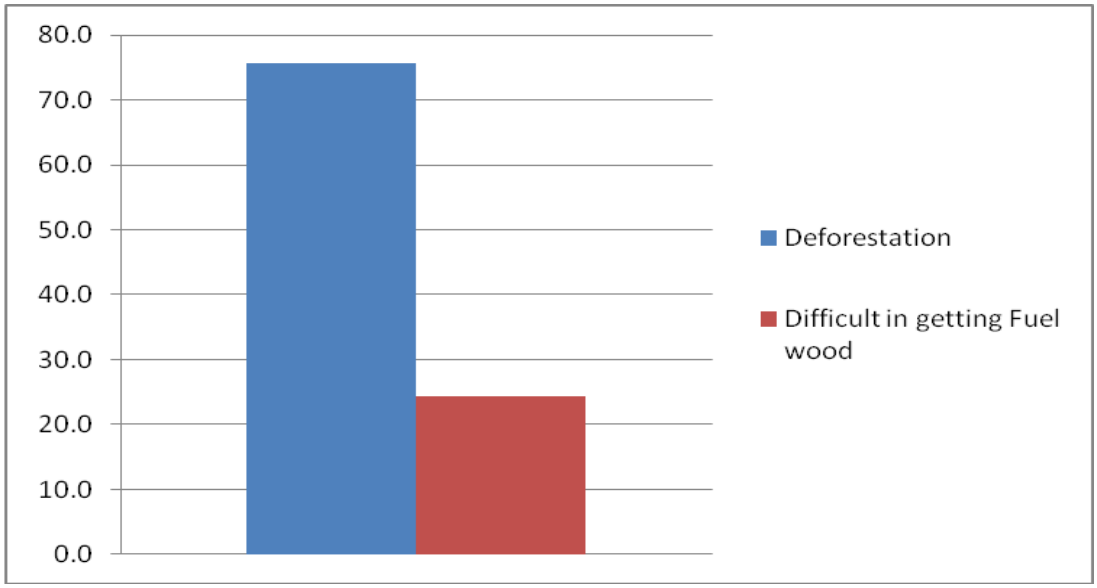


Figure 4.6: The Impacts of ASM Activities on the Forested Land and the Surrounding Communities

Source: Field Data (2015)

Loss of natural resources which have led to shortages of firewood supply, reduced forests and bushes and its effect on ethno-botany (traditional herbalists). Prospecting and mining involves the clearing of vegetation, which results in damages to the banks and beds of rivers and tributaries. Undercut banks and trenches across river banks are visible along the drainage system in the study area. The loosened soil from the river banks becomes susceptible to erosion, and is discharged into the river.

Large tracts of agricultural lands are destroyed as a result of the removal of vegetation and the disturbance of soil structure (See Plate 4.15).

Plate 4.17: The Land Cleared and Left with Pits and Holes after ASM Activities

Source: Field Data (2015)

It was observed that the whole land have been cleared to gives room for mineral exploration and extraction in the area of Kebaga, Kemakondoro and Nyabigena. This finding is similar to the study conducted by Hilson (2003) who wrote occasionally, mining has precipitated deforestation outside of mine regions, as logs have been removed in distant forested areas and then transported to mine sites for use. A great number of other trees have also been threatened by miners that have dug for ore at their bases. Also Nanang (2010) wrote that substantial vegetation loss from mining and deforestation presents difficulties to households in Africa. Forest plays a great role in the planet earth conservation, forest is also a key player to the

hydrological cycle, and it also controls soil erosion. Forest provides food and medicines to most societies. Contamination of these forest resources disturb the whole ecosystem causing the ecological destabilization, to solve these problems sustainable measures such as a forestation, reforestation and land reclamation programs need tom be lunched to preserve the mother nature to its previous state for both present and future generation.

4.4.6 Outbreak of Diseases

Many respondents stated that frequent outbreak of diseases is among the impacts associated or accelerated by ASM activities. About 118 of the 373 questionnaire respondents which are equal to 31.1% said, poor method, technology and education on the extraction of gold have been the source of respiratory diseases such as frequency coughing and chronic Tuberculosis (TB) (See Table 4.3).

Table 4.3: The Cross Tabulation between the Effects of Associated ASM and the Respondents Age where Disease was among the Severed Impacts Caused by ASM

		The effects of artisanal mining activities					Total
		Death buried by Sand	Disease	Water pollution	Land degradation	Conflict	
Age	10-18 Year	0	15	0	21	0	36
	19-35 Year	16	48	23	34	6	127
	36-59 Year	26	47	31	25	5	134
	Above 60 Year	0	6	31	17	0	54
Total		42	116	85	97	11	351

Source: Field Survey

Also the interview conducted reveal that many pits and holes are left free on the ground surface, during the raining seasons they get filled with water and become the mosquito breeding ground causing frequent outbreak of Malaria both in mining and in neighborhood surrounding area. It was observed that pits and holes left which are wide and deep are fully of water (dirty water).

Covered with grasses alongside attracts mosquito to lay plenty of eggs. During the interview one woman said:

> *"……most of the time our children are vulnerable to Malaria, as these pits attracts mosquito lead to Malaria, also some when we parents left home to search for dairy breed do play on these poisonous dirty pond water that are contaminated with bilharzias parasites leading to seriously sickness. Also noise pollution has also lead to psychological problem and hearing impairment to children and elders living around the mining areas, also mercury contaminate water lead to skin diseases"* (05/08/2015 13:00 Hrs).

It was identified that the frequency outbreak of diseases is associated with the mining activities, exposure to these mining areas lead to Tuberculosis (TB) influenced by explosives causing air pollution, Malaria caused by water deposition into the pits and holes, Bilharzias and psychological problems caused by noise pollution. This finding is supported by Hilson (2003) who wrote that these abandoned trenches have ruined the scenic view of the city and pose a danger to humans.

Furthermore, during the rainy season, they become breeding places for mosquitoes infected with Malaria; he also observed other pits that have been filled with water become habitat for the malaria-infected mosquito. Its epidemic form and increasing drug-resistance have made malaria a leading cause of illness and death in forest communities, and the most severe mining-related public health hazard. According to Ghana Health Service (2007) as cited in Amponsah-Tawiah & Dartey-Baah (2011) Statistics from the Inspectorate Division of the Minerals Commission on occupational health problems caused by mining activities from 2000-2004 includes malaria and upper respiratory tract infection, the two topmost causes of outpatient morbidity between 2000-2006.

Also (Rukonge, 2006; WHO, 2001) wrote that much health related cases include malaria, pneumonia, measles, diarrhea and respiratory infection for children is a major threat to ASM activities and the surrounding, women and children are vulnerable, women being primary and second victims during pregnancy complications and children illness respectively. Mwami (2002) wrote that Children abandon school once they get money quickly within a short period of time. The initial intention of engaging in mining may be that the children are looking for money to enable them continue with school and buy uniforms. But later one gets the impression that the job is more paying than the dark future of schooling.

Also Hilton (2002) revealed that as flooding increases the net area of standing water, it also contributes to malaria and other mosquito-transmitted diseases The frequent outbreak of diseases to the working and productive population is the national loss, exposure to these harmful chemical weakens the body immune system, making the

body vulnerable to frequent attach to diseases. The impacts of Malaria, TB, skin problems have a greater effects to the youth, limited education, limited capita, poor technology and lack of the diversified economy have been seen as a source of these problems. The government should offer the awareness and fully equipped civil and technical education so as to improve the general health condition and stability of these human species.

4.4.7 Death

About 45 of the 373 questionnaire respondents which are equal to 12.1% said that many people have died as a result of artisanal small scale mining activities. The interview conducted with the villagers revealed that many people and animals have died as a result of ASM activities. During the interview with many gold buyers at Kemakondoro, one gold buyer said

> *"…….many people are dying in mining related cases for instance in recent months one person was buried is deep underground tunnel while digging sand, also several animals have collapsed to an open pits and holes filled with rain water while grazing"* (03/03/2015 15:00 Hrs)

and similarly during the same day of interview one strong youth man said

> *"……….i don't care whether I will die due to suffocating or roof collapsing or not all I care about now is finding gold"* (03/08/2015 16:00 Hrs)

and these problems have been caused by the ASM activities (See plate 4.14, plate 4.15 and plate 4.16).

Plate 4.18: The Underground Tunnel at Nyabigena Mining Areas, Survey and Literature show these Tunnels to be the Death Traps (Cage) as they Collapse

Source: Field Data (2015)

Loss of life is among the impact of ASM activities on the miners and the neighboring households. About 48 of the 373 questionnaire respondents, which are equal to 12.1%, said that a lot of people have died as results of mining activities. The interview conducted with villagers revealed that many people and animal dies by the collapsing of mining and explosives injuries as in Kebaga and Kemakondoro. This finding is supported by Mwami et al (2002) who observed that death in mining areas have bee also arising from unhealthy sanitary conditions, pulmonary problems and death which arises from major collapses of mine walls and roofs. Also Davidson (1992) as cited in Hilson (2003) wrote that many injuries and deaths in Zimbabwe have been attributed to mining gold at depths of five to eight meters in unsupported pits and tunnels. The ASM activities have lead to death of many young productive age, many youth have been engaged in this deadly activities as their major sources

of income, hence to minimize the impact of these death the government should diversify the economy so as to reduce people who working in these death traps (cage).

4.5 The Coping Mechanisms of the Surrounding Communities to the Impacts of Artisanal Small Scale Mining

For any creature being human or non-human being, adopting to new environment is not an easy thing, however for people living at these mining areas such as Kebaga, Nyabigena and Kemakondoro have very few option to adopt to new changed pattern especially after destruction, degrading and damaging of their fertile arable land, river and forested land. The field data shows the following to be the major adoptive mechanisms, which the neighborhoods around the mining areas and the artisan small scale miner have employed to cope with the situation.

Cultivating along and far from the mining areas, most of people said that they are involved in cultivating along and far from the mining areas. About 139 of the 373 questionnaire respondents which are equal to 37.1% stated that they cultivate along the mining areas and some have borrowed land far from their homesteads or residents where that they cultivate their food crops for home consumption. Also the interviewed respondents said that they have borrowed land far from the mining areas so as to cultivate food crops for their home consumption. During the interview one woman said:

> *"……my land was fertile, arable and very valuable located in a conducive climate for cultivating both food and cash crops, but due to*

> *pollution, degradation done by artisanal small scale miners I do cultivate along the mining area and due to shortage of food I have borrowed extra land far from mining areas where I cultivate enough food"* (07/08/2015 08:00 PM).

Similarly during the interview it was observed most of farming grounds are located along and far about 700 Metres from the mining areas. Engaging in artisanal small scale mining in dry seasons, field data show 203 of the 373 questionnaire respondents which are equal to 54.3% responded that their main activity is mining; however they also engage in farming activities for their domestic consumption, due to mining areas the river dry where they obtain food by buying on market. About 84 of the interviewed woman respondent which is equal to 49.4% and 106 which is equal to 62.3% of male interviewed respondents said that during the dry periods where there is no flow of water they engage fully in artisanal small scale mining in order to generate money to buy food for their home and family consumption, See figure 4.5 and 4,8. During the interview one male respondent started that

> *"…….in previous years my land was good arable land capable of supporting cultivation of both food and cash crops, however in the dry period the pollution, destruction and degradation of water sources and catchment areas the river become dry, this cause me to fully engage in artisanal small scale mining as a way of adopting to this environment which is a big challenge to me"*

Also the interviewed mining owner stated that during the dry season there are many workers than the wet / rain season (08/08/2015 15:00 Hrs).

Engaging in riding motor cycles as a way of surviving the new environment. About 30 of the 373 questionnaire respondents which are equal to 8.4% of questionnaire respondents of which most of them were youth stated that in order to adapt to their new environment they engage themselves in riding commercial motor cycle (BODABODA) (See Figure 4.8. Similarly one 1 of the interviewed respondent that

> *"……currently life have become difficulty than I can explain, mining activity have become risky to human life since gold is currently found far from the surface deep underground, land is no longer arable for food production, with mercury use during the washing of gold from sand, the land have degraded….this have forced many youth including me to engage in motor cycle riding as a source of income for my family"* (09/08/2015 14:00 Hrs).

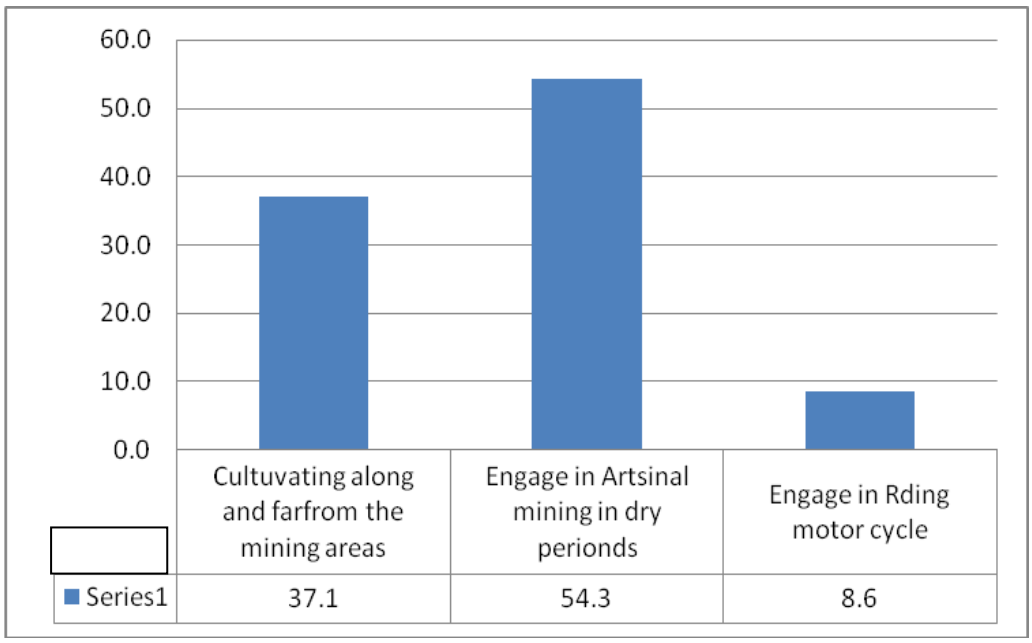


Figure 4.7: Adapting Mechanism by the Miners Around the Mining Areas

Source: Field data (2015)

This chapter presented the findings analysis of the study focus on answering the research objectives. This part presented the finding on the major natural resources that are affected as a result of small scale mining. Furthermore the chapter presented the findings on the effects of artisanal small scale miners on land, water and forest effects like deforestation, death, disease drying of the river streams. The chapter finally presented the findings on the mechanism adopted by small scale miners and the neighbor communities to survive from the impact of small scale miners on their environment.

It was noted that the neighborhoods have used different strategies to cope with these problems by engaging in ASM in dry seasons. The survey data showed that about 205 of the 373 questionnaire respondents which are equal to 54.9% said that their main source of income is small scale mining, however they also engage themselves in small scale agriculture. The reduction of water in the streams and sometimes drying of water sources in dry periods, due to dry of water sources it becomes difficult to cultivate and this makes them to fully engage themselves in mining activities to generate money to buy food on the market for their families. Also 49% of the interviewed women respondents and 62% male interviewed respondents said during the dry seasons where there are very small flow of water they also engage fully in ASM activities to raise their income. This finding is supported by Hilson (2003) who wrote that agriculture previous was identified as mainly a secondary source of income. The expansion of quarrying has largely affected the condition of agriculture by making it physically impossible. As many people currently do engage in ASM as both primary and secondary sources of income.

This chapter presented the finding discussion integrating the study finding and the literature including the related study conducted in different locale. The chapter presented the findings and discussion on the major resources affected by miners including resources like land, water and forest. Furthermore the chapter presented the discussion on the impacts of small scale miners on these resources and the surrounding environment and finally it discusses the adaptation mechanisms adopted by these communities to cope with these impacts triggered by small scale miners.

4.6 Chapter Summary

A study sample of 154 households (respondents) accounting 90% of the targeted population engaging in Artisanal and Small scale Mining were involved in he study. Through observation, interviews and questionnaires, both sexes including children were working in the ASM activities. The field data from the research tool checklist in the field indicated that land, water and forest resources are severely affected by the mining activities.

The land has completely degraded with holes, pits heaps of accumulated rock debris and pollution, water in the area are dusted, silted, contaminated with heavy metals like mercury and cyanide and the dried wells, streams and rivers. The land is bare from deforestation, which led to distortion of earth ecosystem.

The non-miners population has diversified their economic daily livelihood of agriculture into petty business, hawking, motorcycle transport (bodaboda) and to some extent micro agriculture hiring of land from a distant villages.

With limited domestic water supply, contamination, filled holes and ponds the field data findings have proven that there are frequent outbreaks of epidemic diseases such as acute malaria, bilhaziasis and human and animal injuries and death cases from accidents.

CHAPTER FIVE

CONCLUSION, RECOMMENDATION AND AREA FOR FURTHER STUDIES

5.1 Conclusion

As a rule, ASM in Tarime Districts especially in Kemakondoro, Kebaga and Nyabigena plays a significant role in rising the economic status of both the Nation and the community at the household level, its importance lies in the fact that it provides employment to a sizable number of artisanal gold diggers in the district and make a positive aspect of the sector, and it also acts as the main source of income through which the community earn their living in these areas. However, it is evident from the study findings that even though the ASM plays a tremendous role in imposing the socio-economic status, it is not done in a sustainable manner.

The study exposes that ASM activities impacts the environment by causing deforestation, soil erosion, damage to water quality, pollution, and harm to livestock and wildlife biodiversity and land degradation as it was observed. The field data show that many household of Kemakondoro, Kebaga and Nyabigena are affected by contamination of water sources caused by discharge of mainly mercury by artisanal miners when they wash gold ore in the purification process. It was found that the Artisanal Small Scale miners are faced with inefficient methods and equipment Environmental, health, and safety problems arising from the practice of haphazard mining. This study has managed to answer all research questions and the study objective as all question has successful answer the study question widely.

The research findings have proved clearly by answering the general objective of the study, and furthermore all three above outlined specific objectives were answered when through questionnaire and interview mentioned and identified the prime natural resource of land, water and forest as being excessively degraded, polluted and destroyed through ASM activities.

5.2 Recommendations

Basing on the research findings on the way environment have become degraded, water pollution, destruction of forest, land degradation, human health deterioration, and community destabilization. The following recommendations should be taken into consideration for the benefit of the present and future generations:

(a) The government by cooperating with the private sector should introduce technical training and health education to the ASM and the surrounding communities on modern mining methods towards sustainable exploitation of mineral resources.

(b) The government should provide capital and financial assistance to enable these ASM to acquire modern mining technology for sustainable mineral extraction. In addition to that for solving the land shortage for agro economy stain measures should be taken of land reclamation programs to restore the degraded land for the benefit of both present and future generations.

(c) There should be the expansion of social services such as water to help indigenous from drinking polluted and mercury contaminated water, as women and children are those who are mostly affected by the scarcity of water.

(d) The ministry of finance and work should introduce massive diversification of the economy from ASM dependence to other non-mining activities through provision of education on the impacts of ASM to their community and their environment. It is further recommended that agriculture should be given first (1^{st}) priority as most of the ASM who accounted the total of 95% argued that apart from ASM activities their other activities is agriculture.

(e) The government through its ministry of Environment and Union through National Environmental Management Council (NEMC) requires to introduce measures needed to protect these precious resources, the resources like water, land and forest being so importance to the sustainability to the society they need to be protected and preserved.

(f) This study therefore advices the government to formulate a proper policy to that empowers the local government at the place to supervise the environment even to the individual level.

5.3 Areas for Further Study

The research conducted in this dissertation has led to some useful results and conclusions on the impact of ASM on land, water and forest resources; also it has also uncovered many areas that need additional study. The limitation in scope and time constraints makes it not possible to discourse all key areas outside, but related to, the principal points of this part. It was however, identified some key areas which should be scrutinize further to accumulate more knowledge. The purpose of this part is therefore to identify and discuss the need for further research in the following areas

(a) **To what extent the ASM is worthwhile in raising the local and national economy**, The Artisanal and Small Scale mining widely support the livelihood of neighboring communities as well as the national income.

(b) **The awareness of the Artisanal and Small Scale Miner's activities on their impacts to their environment**, it was observed and supported by plenty of literatures that the majority of Artisanal and Small Scale Miner's are carrying their daily activities unsustainably risking their health and degrading their environment.

(c) **Basing on the nature of the respondents, the question relating to the coping mechanism was not well answered by the finding**, although this part was one of the objectives it was not covered well due to time limit and poor response from the respondents. Conducting the new study in this field may contribute to the enrichment of new knowledge.

(d) **To reduce the impact both** to mining communities and environment, education program should be production with help of technology so as to reduce the impact.

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APPENDICES

Appendix I: The Checklist for Observation Infrastructure, Process and Tools used by the ASM as Well as the Impacts OFASM on Water, Land, Forests, Resources

Please put a tick [√] for the appropriate answer in the box provided and fill the left space.

SN	QUESTIONS	YES	NO
1.	Are the roads wide enough to reduce road accidents?		
2.	Do road have enough road traffic signs?		
3.	Do drivers adhere to the driving regulations while driving?		
4.	Do the qualities of transport facilities favor the transport of passengers?		
5.	Do the pedestrians follow the road safety rules while crossing the road?		
6.	Do the motorcycle riders use or wear Helmets while riding?		
7.	Are the roads of Iringa municipality having a quality for effectiveness of road transport?		
8.	Is the nature of the roads satisfying the number of the vehicles that passing through?		
9.	Are road traffic signs enough to ensure effectively and safety use of the road?		

10.	Are the drivers and traffic officer playing their role in preventing the occurrences of road accidents?		
11.	Are the roads far away from peoples` settlements?		
12.	Do the motor vehicle drivers fasten the seat belt while driving?		

Appendix II: Madodoso Yanayohusu Taarifa Utambulisho Binafsi

1. Una umri gani?

   (a) miaka 10 – 18 ☐

   (b) miaka 19 – 35 ☐

   (c) miaka 36-59 ☐

   (d) miaka zaidi ya 60 ☐

2. Nini jinsi yako

   (a) ME ☐

   (b) KE ☐

3. Wewe ni mzaliwa wa eneo/kijiji hiki?

   (a) Ndiyo ☐

   (b) Hapana ☐

4. Nini shughuli (kazi) zako za kila siku

   (a) Kilimo na ufugaji ☐

   (b) Uchimbaji mdogo mdogo ☐

5. Kama wewe ni mchimbaji mdogo mdogo kuna namna yeyote kazi yako inaathiri mazingira unayoishi?

   (a) Ndiyo ☐

   (b) Hapana ☐

DODOSO LINALOHUSU AINA ZA UHARIBIFU KWENYE RASLIMALI

6. Unaweza kutaja mali asili/mazingira zinazoathirika kutokana na shughuli za uchimbaji madini katika eneo unaloishi

(a) ……

(b) ……

(c) ……

(d) ……

(e) ……

(f) ……

(g) ……

DODOSO LINALOHUSU AINA ZA ATHARI ZA WACHIMBA KWENYE RASILIMALI MAJI

Tafadhari weka alama ya "V" kwenye kifungu kinachokuhusu

7. Maji unayotumia hutokana na

(a) bomba la serikali ☐

(b) kisima cha kuchimbwa na binadamu ☐

(c) kisima cha asili ☐

(d) mto ☐

8. Maji unayotumia hupatikana kwa urahisi)

(a) Ndiyo ☐

(b) Hapana ☐

9. Maji yatumikayo majumbani kwako hutekwa umbali gani kutoka hapa

(a) Chini ya mita 400 ☐

(b) Mita 500 – 1000 ☐

(c) Zaidi ya mita 1000 ☐

10. Kwa nini hautumii maji yaliyo karibu na unapoishi

(a) Hayapo ☐

(b) Yapo lakini ni machafu ☐

11. Kama yaliopo ni machafu, yamechafuliwa na nani?

(a) Wachimba madini kuoshea dhahabu ☐

(b) Mifugo ☐

(c) Yamechafuka yenyewe ☐

12. Je uchimbaji wa madini huambatana na matumizi ya maji?

(a) Ndiyo ☐

(b) Hapana ☐

13. Ni kwa vipi maji ni muhimu wakati wa uchimbaji wa madini

(a) ……..……..……..

(b) ,…….……

(c) ……..……

(d) ……..

(e) …….

14. Ukiwa kama mchimbaji mdogo mdogo wa madini, je shughuli zinazoamabatana na uchimbaji huo huathiri maji unayotumia?

    a) Ndiyo ☐

    b) Hapana ☐

15. Unaweza kutaja athari zilizotokana na shughuli za uchimbaji madini jirani

    (a) ……

    (b) ……

    (c) ……

DODOSO LINALOHUSU AINA ZA ATHARI ZA WACHIMBA KWENYE RASILIMALI ARDHI

16. Kama mtu unayetegemea kilimo katika shughuli zako za kila siku, Uchimbaji wa madini umekuathiri kwenye shughuli zako?

    (a) Ndiyo ☐

    (b) Hapana ☐

17. Kama Jibu ni NDIYO umeathirika kivipi

    (a) ……

    (b) ……

    (c) ……

    (d) ……

18. Unaweza kulima eneo lako kwa kutumia wanyama kazi?

    (a) Ndiyo ☐

    (b) Hapana ☐

19. Kama jibu lako ni HAPANA, ni kwa nini?

    (a) Gharama zake ziko juu ☐

    (b) Eneo lote limetapakaa mashimo hivyo ng'ommbe au trekta vyaweza kutumbukia ☐

DODOSO LINALOHUSU AINA ZA ATHARI ZA WACHIMBA KWENYE RASILIMALI MISITU/MIMEA

20. Kabla ya kuanza uchimaji wa madini eneo hilo lilikuwa lina …

    (a) Misitu ☐

    (b) Mto ☐

    (c) Makazi wa watu ☐

    (d) Mazao ya chakula ☐

21. Nini kilifanyika kabla ua kuanza uchimbaji madini katika eneo hilo….

    (a) ……

    (b) ……..……..

    (c) …….…….……..

    (d) ……

22. Uchimbaji wa madini huambatana na athari zozote kwenye misitu?

    (a) Ndiyo ☐

    (b) Hapaba ☐

23. Unaweza kutaja athari zinazotokana na shughuli za uchimbaji madini kwenye misitu inayozunguka makazi yako

(a) ……

(b) ……

(c) …...……

(d) ……..……

DODOSO LINALOHUSU HATUA BINAFSI MBADALA KWENYE RASLIMALI ILIYOHARIBIWA

24. Kama hiyo ndiyo hali halisi, wewe mkulima unajikimu kwa namna gani

(a) ……

(b) ……

(c) ……...……

(d) ……..……

(e) ……

Appendix III: Maswali ya Mahojiano kwa Wachimbaji Wadogo wa Dhahabu (Wafanyakazi)

1. Je unajishudhulisha na uchimbaji wa madini kwa mwaka mzima?

   (a) NDIYO ☐ HAPAN☐

   (b) Kama NDIYO unashughulika na nini.

   (i) kuchimba

   (ii) kusomba mchanga.

   (iii) kuchakata mchanga kwa mercury.

   (iv) kusomba mchanga wadhahabu

   (c) kwa kipindi ambacho huchimbi dhahabu huwa unajishughulisha na nini?

   …….

2. Unakazi nyingine inayokuingizia kipato tofauti na uchimbaji?

   NDIYO ☐ HAPANA ☐

3. Nini chanzo kikuu cha mapato? .....

   ……...……

4. (a) Kuna watu wangapi katika kaya yako hushughulika na uchimbaji?

   Wanaume …… wanawake ….……. Watoto.....…….

   (b) Je uchimbaji wao ni wa musimu/mwaka mzima? …….

5. Kwa wasiojihusisha na uchinbaji kwenye kaya yako hushughulika na nini?

   ……

6. (a) Unatumia mercury kuchakata dhahabu?

   NDIYO ☐ HAPANA ☐

(b) Kama ndiyo unaipata wapi hiyo mercury? ……

(c) Unatumia kiasi gani cha mercury kuchakata tani moja ya mchang.....

7. Unafahamu juu ya madhara ya mercury?

NDIYO ☐ HAPANA ☐

8. Kama ni ndio unayo mavazi maalumu ya kujikinga na madhara ya mercury.

NDIYO ☐ HAPANA ☐

9. Unachakatia wapi mchanga wako? ……

10. Unachomea wapi dhahabu yako? .....

11. Unatumia nini kuchomea dhahabu yako? ……..moto?kurunzi maalum

12. Unaonaje mazingira ya kufanyia kazi yako? Mabaya……., Yanaridhisha yakiboreshwa……, mazuri ……

13. Ni kwa vipi mazingira yako yanaweza kuboreshwa?.....

14. (a) Ungependa kunufaika na tekinolojia bora ya uchimbaji wa dhahabu?.

NDIYO ☐ HAPANA ☐

(b) Uko tayari kupokea mafunzo ya kuboresha kazi yako?.....

15. Nini chanzo cha maji unayoyatumia nyumbani?

(a) Mvua

(b) Lambo / bwawa

(c) Mto

(d) Kisima kirefu

(e) Kisima kifupi

(f) Bomba la maji

16. Maji hayo ni bora?

(a) Mazuri

(b) Tope

(c) Siyo salama

17. Ni wakina nani wanaoteka maji?

(a) Wanawake

(b) Wanaume

(c) Wavulana

(d) Wasichana

Kuna umbali gani kutoka kwenye chanzo cha maji?..... km au ……saa

18. Chanzo cha nishati unayoitumia?

(a) Kuni

(b) Umeme

(c) Jenereta

(d) Mafuta ya taa

19. (a) Unaendesha shughuli za kilimo?

NDIYO ☐ HAPANA ☐

(b) Kama NDIYO ni cha aina gani? Kibiashara…….. chakula?.....

20. (a) Je, unalima mazao yako na kufuga mifugo yako mwenyewe

NDIYO ☐ HAPANA ☐

(b) Kama jibu lako ni NDIYO unalima mazao gani?.....

na kama unafuga mifugo gani?.....

(c) Kama haulimi na haufugi ni nini chanzo cha chakula unatumia……

21. (a) Je unafanya shughuli nyingine ngumu tofauti na za uchimbaji?

NDIYO ☐ HAPANA ☐

(b) Kama jibu ni NDIYO ni shughuli gani?.....

22. Unapata kiasi gani kutokana na uchimbaji wa madini kwa siku? Tsh.....

23. (a) ungependa kuendelea kujihusisha na uchimbaji wa dhahabu?

NDIYO ☐ HAPANA ☐

(b) Kama ni NDIYO kwa namna gani na wapi?.....

24. Ni wanawake wangapi katika eneo hili wanaojihusisha na madini?

……

Appendix IV: Maswli ya Mahojiano kwa Wamiliki wa Migodi

1. Ni lini ulianza shughuli za uchimbaji wa madini…….....
2. Je umeajili wachimbaji wangapi? Wafanyakazi wa kuhudumu……., wafanyakazi wa muda.
3. (a) Ni wafanyakazi wangapi kati ya hao ulioajili wameoa? …….
   (b) Je familia zao ni kubwa kiasi gani? ……..
4. (a) Je uliwahi kifiwa na mtumishi wako?.

   NDIYO ☐ HAPANA ☐

   (b) kama ni ndiyo ni wangapi?.....

   (c) Je vifo vyao vinahusiana na uchimbaji wa madini?.....

5. (a) Wafanyakazi wako wanaishi wapi? Machimboni/Mbali na machimboni…….

   (b) Ni kwa umbali gani makazi yao toka machimboni…….

6. Ni nini chanzo cha maji nyumbani kwao?
   (a) Mto
   (b) Lambo/bwawa
   (c) Kisima kifupi
   (d) Kisima kirefu

7. Ni kwa namna gani hali/mazingira ya uchimbaji madini inaweza kuboreshwa?.....

.....

.....

8. (a) Unamiliki migodi mingapi? …….

(b) Je hiyo migodi inapatikana wapi? …….

(c) Je kwa tani moja ya mchanga utapata kiasi gani cha dhahabu?

…….……gramm/tani

9. Je unamiliki vifaa gani vya kuchimbia dhahabu? Weka alama panapo kuhusu.

(a) Sepetu

(b) Picks

(c) Toroli

(d) Nyundo

(e) Patasi

(f) Kompresa

(g) Mzani

(h) Vingine (tafadhari vitage)

10. Unatumia miundo mbinu gani kuchinbia madini? Weka alama ya vyema … panapostahili.

(a) Shafti

(b) Mili

(c) Karo la kuonyeshea

Appendix V: Research Budget

S/N	ITEM	Quantity	Cost	Total Cost
1.	Writing paper	2 ream	10,000	20,000
2.	Pencil	1 doz	2000	2,000
3.	Ruler	6 pcs	500	3,000
4.	Printing	300 pages	500/	150,000
5.	Digital camera	1pc	250,000	250,000
6.	Flash memory	2 pcs	10,000	20,000
7.	Photocopying	1000 pages	50/	50,000
8.	Binding	4 booklets	2000	8,000
9.	Transport	4 persons	200,000	200,000
10.	Meal and accommodation	4 persons	300,000	300,000
	TOTAL			1,003,000/

Appendix VI: Research Timetable Schedule

S/N	Actual	Events	
		Start study	**End Study**
1.	Submission of Research to the supervisor	31.1.2015	27.02.2015
2.	Defending Report Proposal	28.02.2015	02.03.2015
3.	Submitting the signed proposal	15.03.2015	20.03.2015
4.	Data collection	27.03.2015	15.04.2015
5.	Data analysis	22.04.2015	30.04.2015
6.	Presenting draft of research report to supervisor	30.04.2015	05.05.2015
7.	Presenting 2nd draft to the supervisor	25.05.2015	30.05.2015
8.	Presenting the final report for approval	29.06.2015	09.06.2015
9.	Presenting and submission of the final signed dissertation to the research coordinator	25.07.2015	31.07.2015